National Assessment of the Existing Criteria Pollutant Monitoring Networks

O_3, CO, NO_2, SO_2, Pb, PM_{10}, $PM_{2.5}$

Draft 1 - June 25, 2001

Assessment Details - Measures

- In this assessment, five independent measures were used to evaluate the AQ monitoring network performance.

  - Pollutant Concentration is a measure of the health risk. The concentration metrics used for each pollutant correspond to the associated NAAQS'. [See next slide.] The stations with the highest concentration values are ranked 1.

  - Deviation from NAAQS measures the station's value for compliance evaluation. The station ranking is according to the absolute difference between the station value and the NAAQS. The highest ranking is for the station whose concentration is closest to the standard (smallest deviation). Stations well above or below the standard concentration are ranked low.

  - Estimation uncertainty measures the ability to estimate the concentration at a station location using data from all other stations. The station with the highest deviation between the actual and the estimated values (i.e. estimation uncertainty) is ranked #1. In other words, the stations who's values can be estimated accurately from other data are ranked (valued) low. The error estimation calculation used "jack-knifing" approach by removing each monitor and estimating a concentration at the removed monitor location. Error=Abs(Error-Actual). The estimated concentration is calculated using declustered, $1/r^2$ interpolation using the nearest 5 stations within a 750 km search radius.

  - Spatial coverage measures the geographic surface are each station covers. The highest ranking is for the station with the largest area in it's sampling zone. This measure assigns high relative value to remote regional sites and low value to clustered urban sites with small sampling zones. ArcView's proximity analysis function was used to generate polygons for each monitor that encompass the area closer to that monitor than any other monitor. The polygon file is saved as a shapefile and then ArcView's function for calculating area of polygon was used.

  - Persons/Station measures the number of people in the 'sampling zone' of each station. Using this measure the station with the largest population in it's zone is ranked #1. Note: Estimating the health risk requires both the population and the concentration in the sampling zone. Population data used is 1999 estimated population in census tracts. If the centroid of a census tract is located in a "monitor polygon" as derived above, the population for that tract is assigned to that monitor. The sum of all tract populations in a polygon is the total population for a monitor. You'll notice many monitors have populations of zero. This caused by either no tract centroids falling within that monitor's polygon or all of its tracts have zero population (hundreds of tracts have populations of zero.) No population data was available for Puerto Rico or Virgin Islands.

Assessment Details - Metrics and Years

•The metrics and years used for the three concentration-based measures were:

Pollutant	Primary National Ambient Air Quality Standard (NAAQS), from *Trends Report*		Surrogate Metric Used in This Assessment
	Type of Average	Standard Level Concentration	
O_3	Maximum Daily 1-hour Average[a]	0.12 ppm	**1995-1997 & 1998-2000 3-year averages of annual 2nd daily max 1-hour**
	4th Maximum Daily 8-hour Average[b]	0.08 ppm	**1995-1997 & 1998-2000 3-year averages of annual 4th daily max 8-hour**
CO	8-hour[a]	9 ppm	**1998-2000 3-year average of 2nd max 8-hour**
	1-hour[a]	35 ppm	**1998-2000 3-year average of 2nd max 1-hour**
NO_2	Annual Arithmetic Mean	0.053 ppm	**1998-2000 3-year average of annual means**
SO_2	Annual Arithmetic Mean	0.03 ppm	**1998-2000 3-year average of annual means**
	24-hour[c]	0.14 ppm	**1998-2000 3-year average of annual 2nd max interval Z**
Pb	Maximum Quarterly Average	1.5 µg/m^3	**1998-2000 3-year average of annual max quarterly mean**
PM_{10}	Annual Arithmetic Mean	50 µg/m^3	**1998-2000 3-year average of annual means**
	24-hour[c]	150 µg/m^3	**1998-2000 3-year average of annual daily 2nd max's**
$PM_{2.5}$	Annual Arithmetic Mean[d]	15 µg/m^3	**1999-2000 2-year average of annual means**
	24-hour[e]	65 µg/m^3	**1999-2000 2-year average of annual 98th percentiles**

*Note: 1-hr and 8-hr ozone were treated as different pollutants.

[a] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one, as determined according to Appendix H of the Ozone NAAQS.
[b] Three-year average of the annual 4th highest daily maximum 8-hour average concentration.
[c] Not to be exceeded more than once per year.
[d] Spatially averaged over designated monitors.
[e] The form is the 98th percentile

Assessment Outputs

- The preliminary outputs for the National Assessment are:
  - Maps for each pollutant-metric-measure delineating sites in the….
    - Top National quartile ('most important') - red markers
    - Bottom National quartile ('least important') - blue markers
    - Middle 2 National quartiles - black markers
  - A composite map for each pollutant aggregating all metric-measures…. using equal weighting
  - A table of the actual Q1 and Q3 threshold values… for each pollutant-metric-measure
  - Bar charts for each pollutant-metric measure (and aggregate pollutant) showing the Regional breakdown of percent of sites in the National quartiles
  - Spreadsheets (separate from this file) for each pollutant showing….
    - The actual calculated values for each metric-measure
    - The corresponding National ranking
    - The corresponding National quartile
  - An aggregate pollutant map…. Aggregates all composite pollutant maps… using equal weighting for each pollutant measured at the site
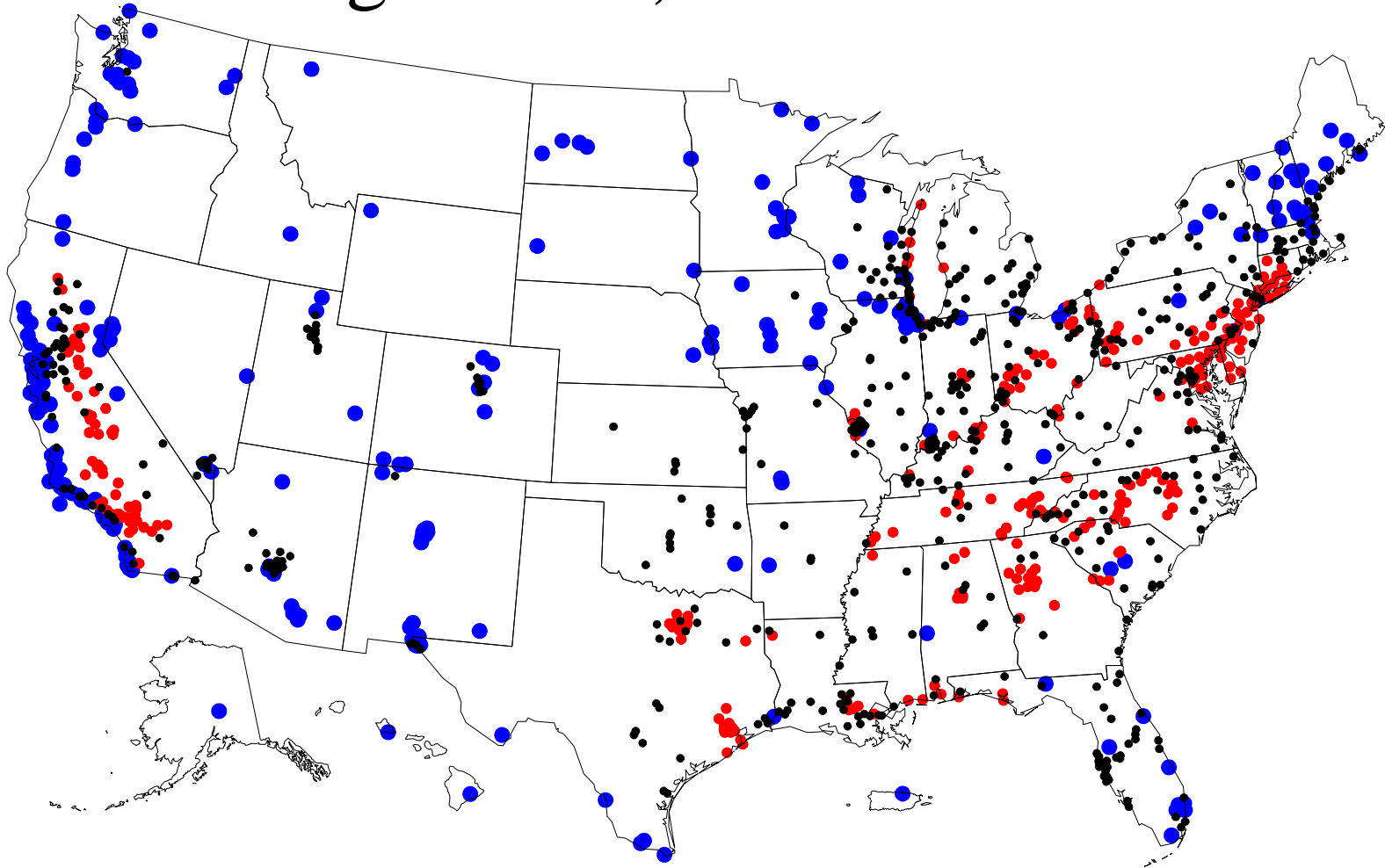
95-97 1-Hour O3 2nd Max:
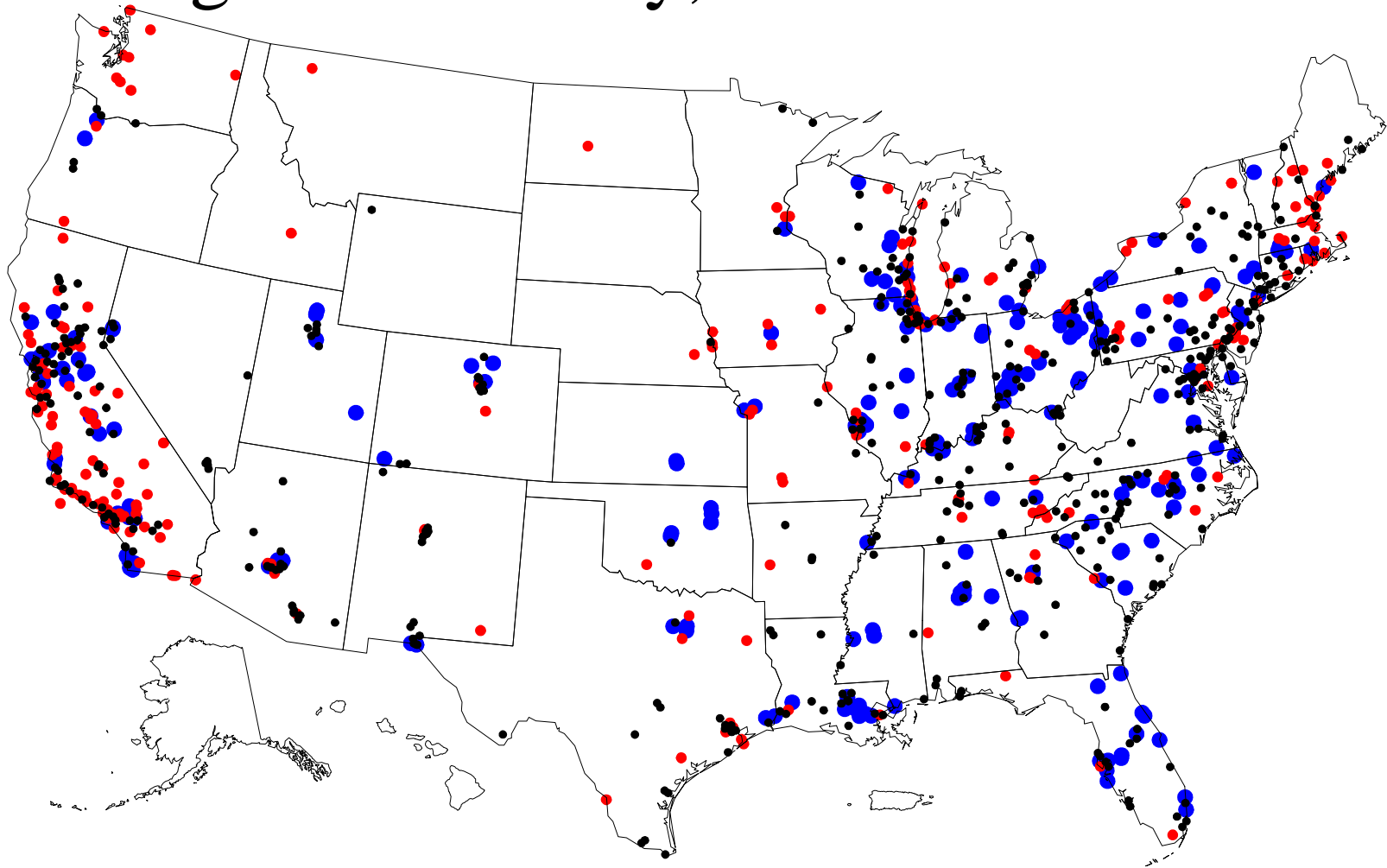# Red=Large Value, Blue=Small Value
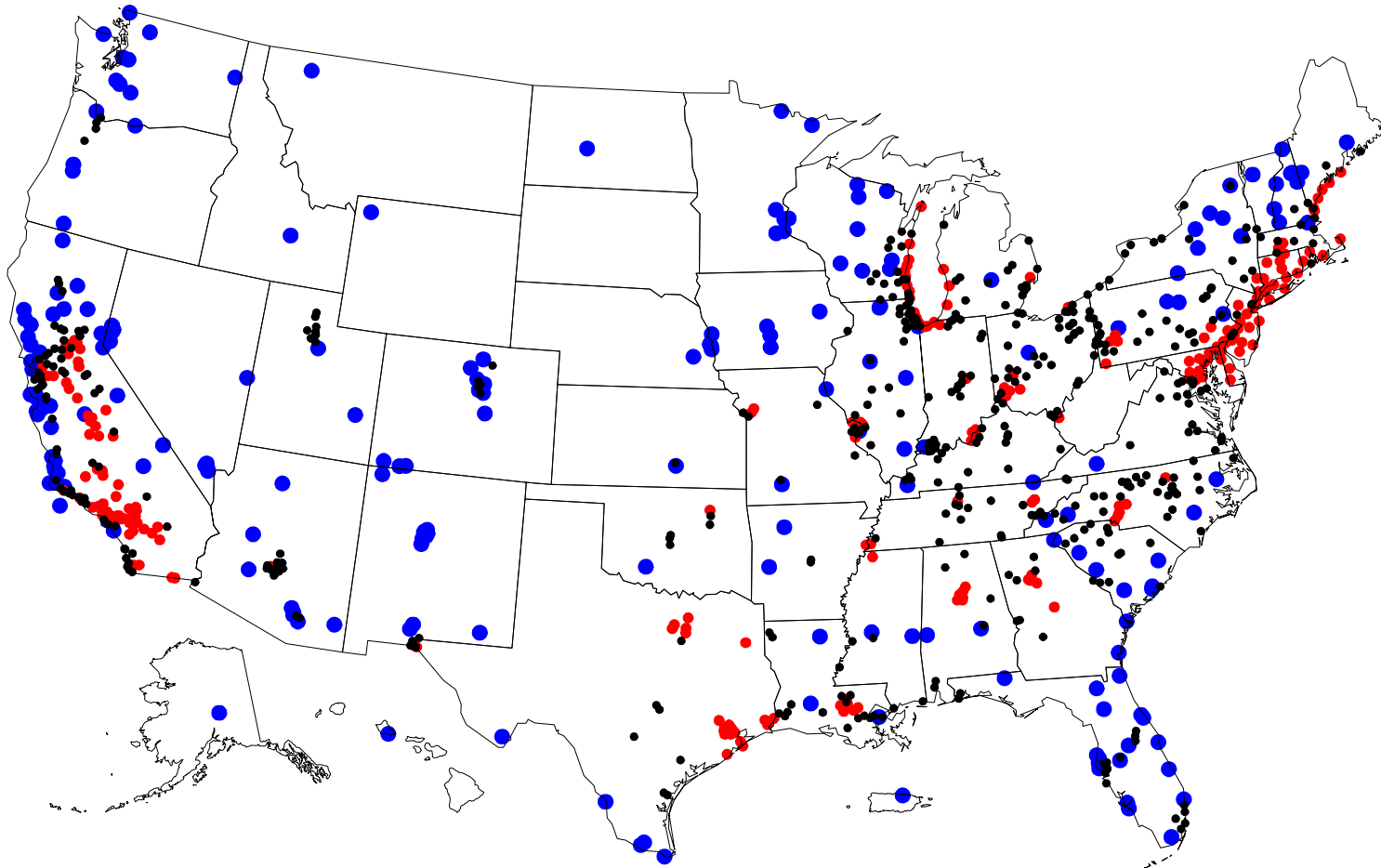
95-97 1hr O3 2nd Max Red=Large Value. Blue=Small Value

98-00 1-Hour O3 2nd Max:
# Red=Large Value, Blue=Small Value
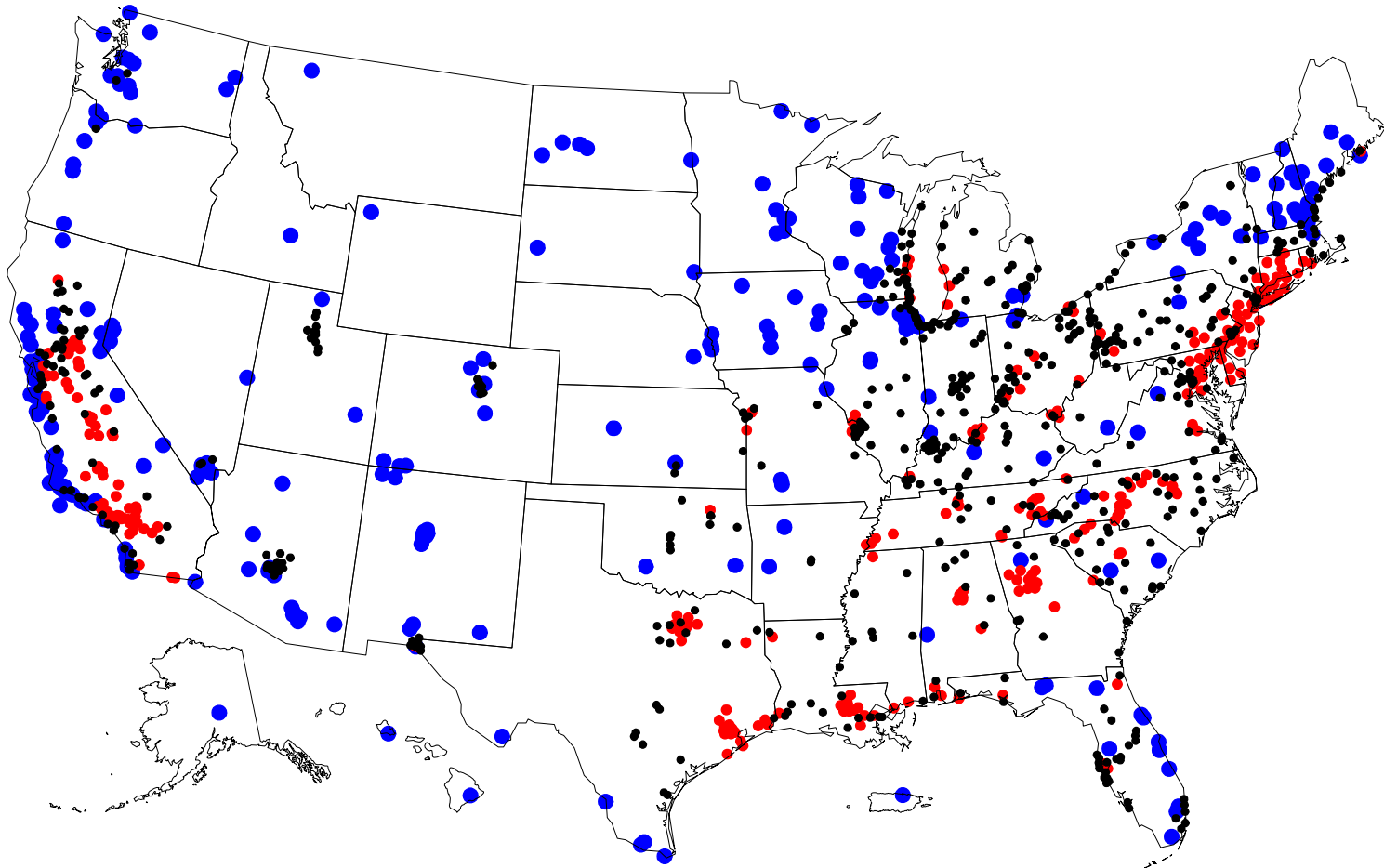
98-00 1hr O3 2nd Max: Red=Large Value, Blue=Small Value

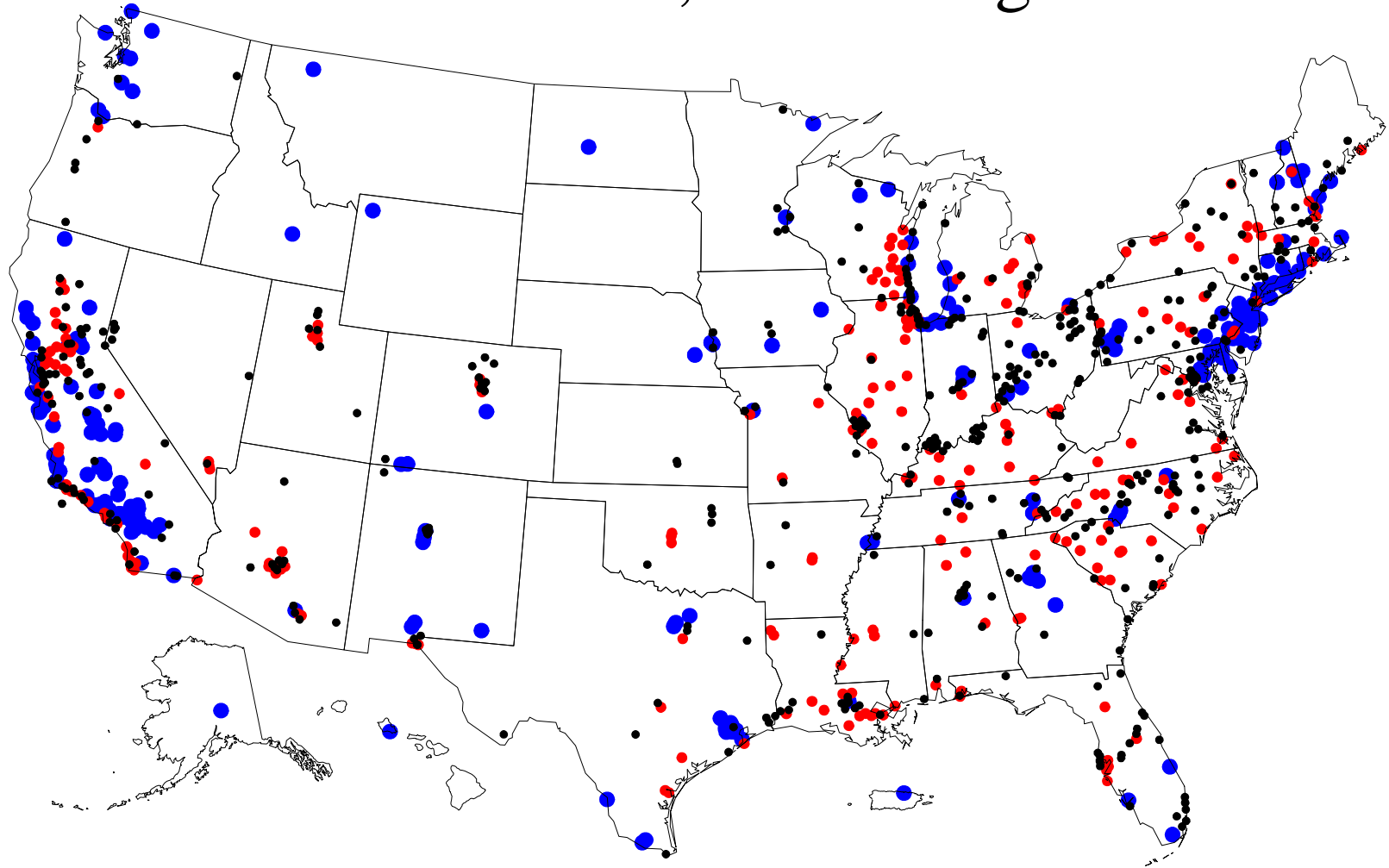# Predicting 1hr O3 2nd Max (95-97): Red=High Uncertainty, Blue=Low Uncertainty
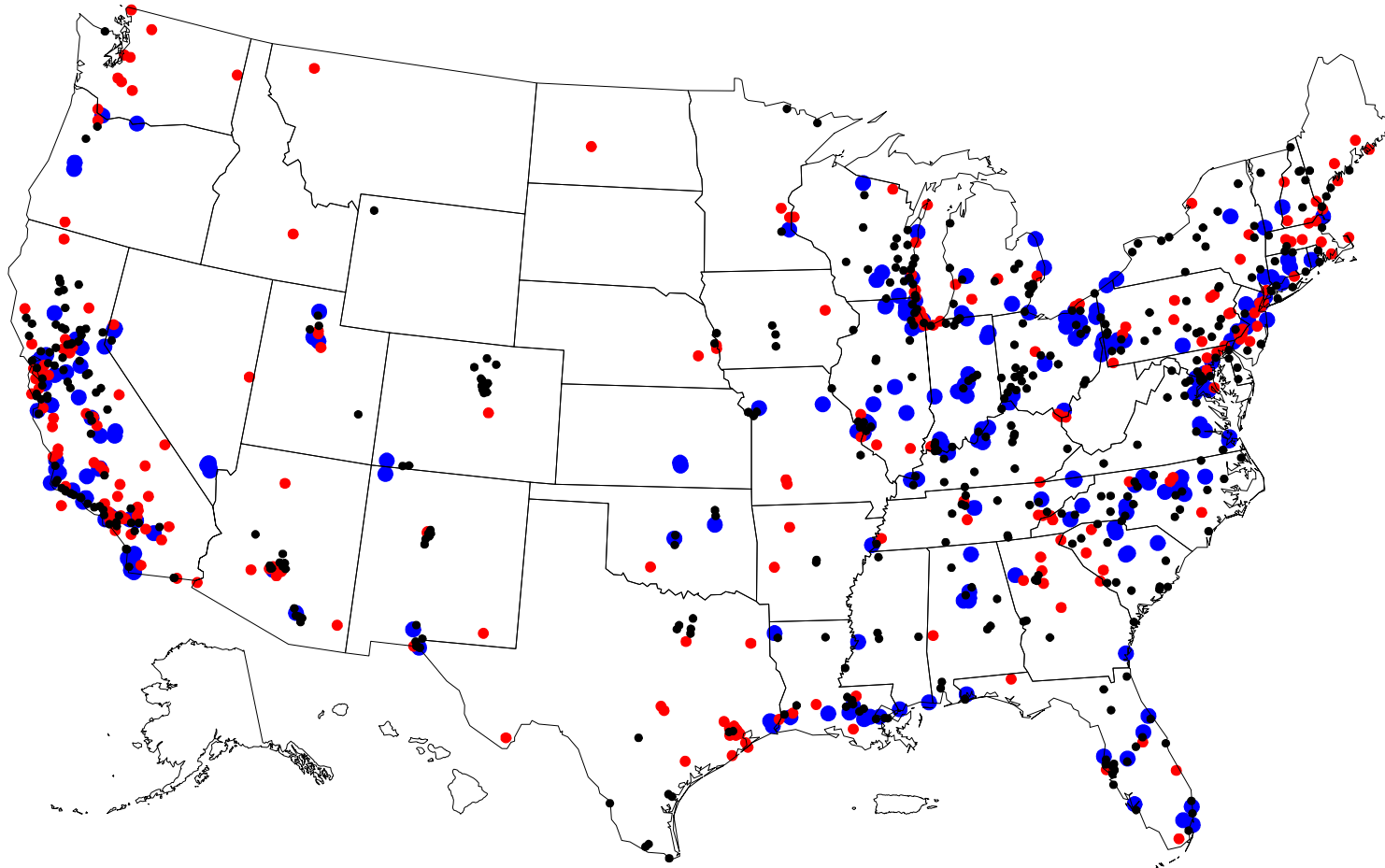
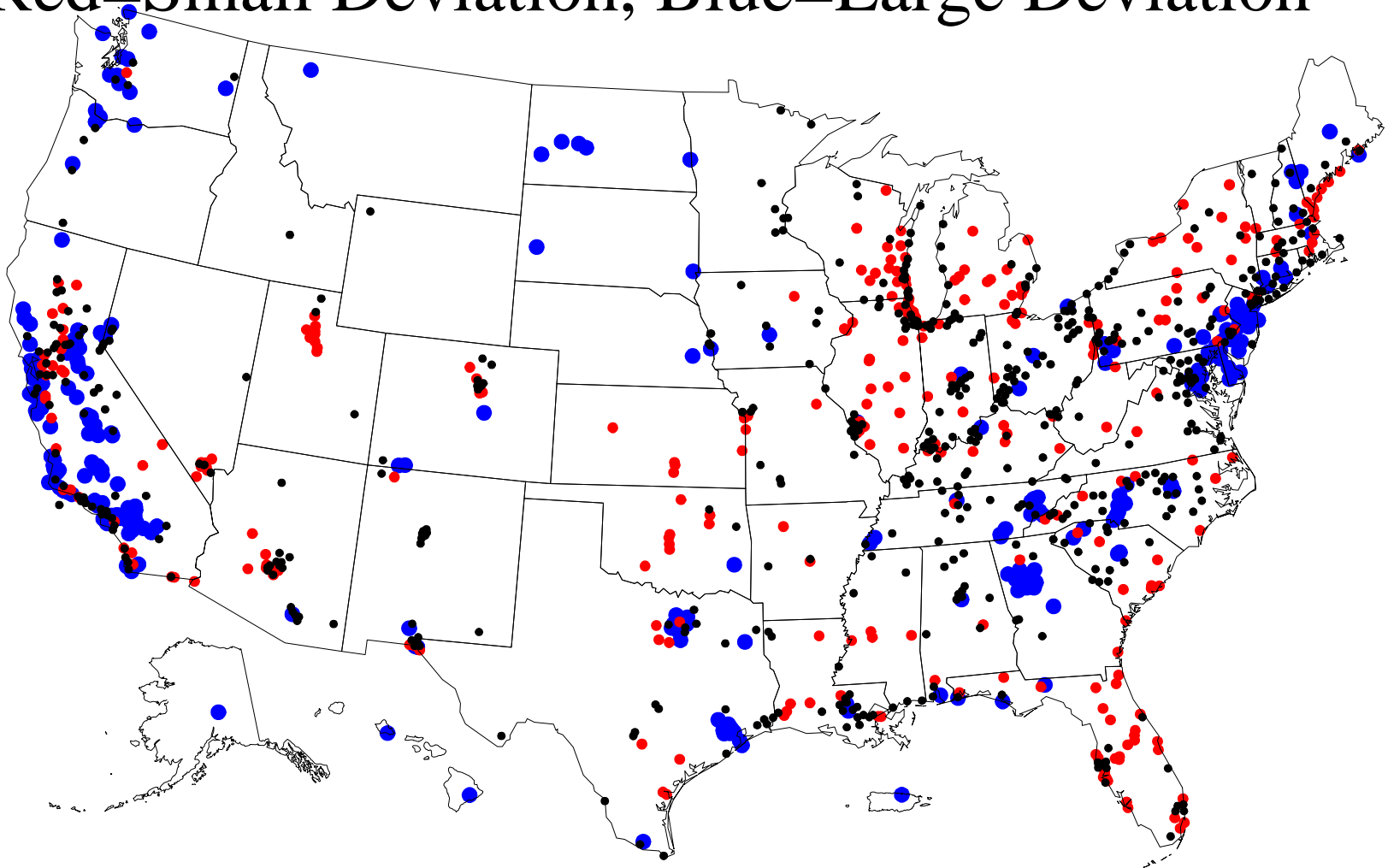Predicting 1hr O3 2nd Max (95-97): Red=High Uncertainty, Blue=Low Uncertainty

Predicting 1hr O3 2nd Max (98-00): Red=High Uncertainty, Blue=Low Uncertainty
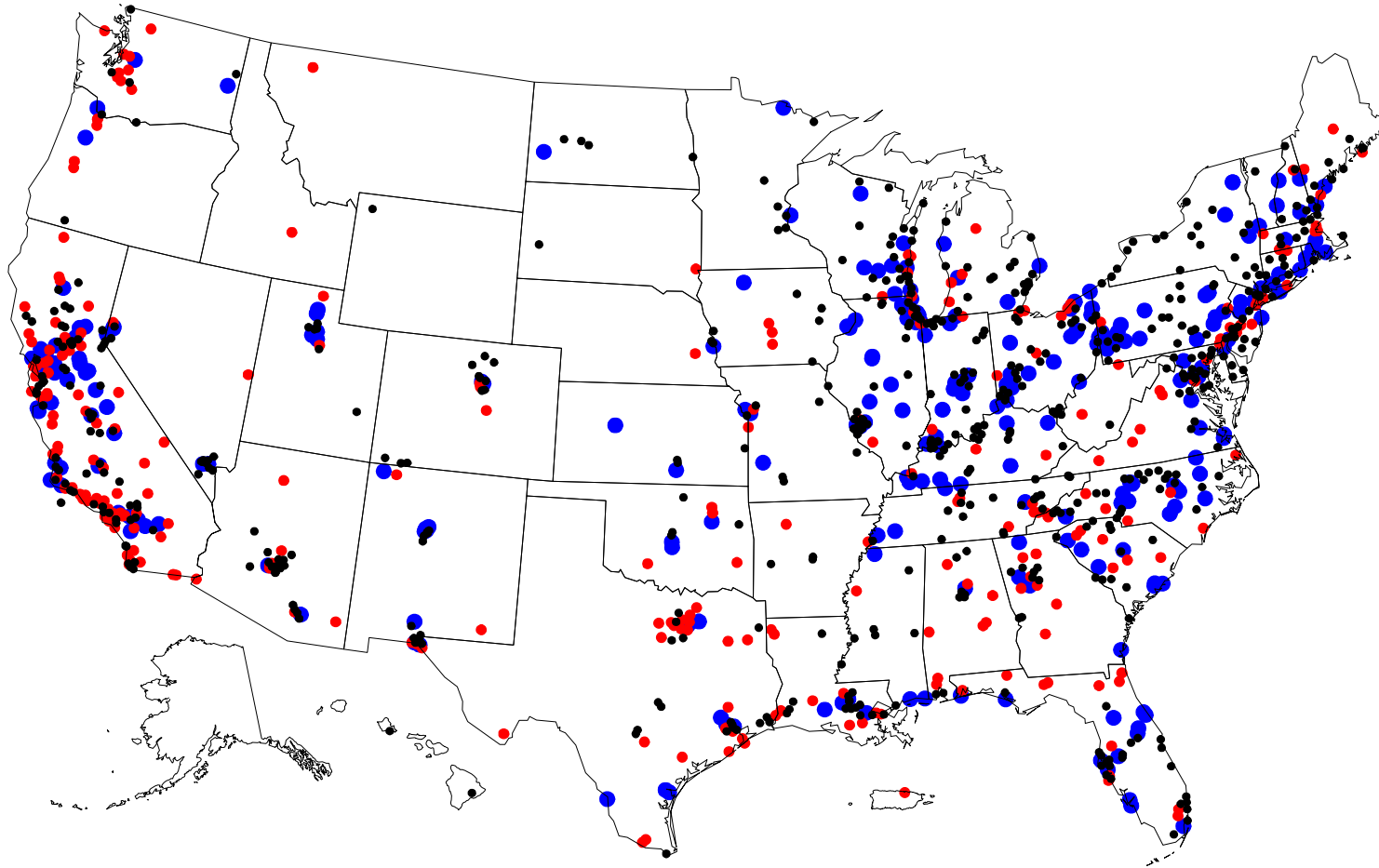
Predicting 1hr O3 2nd Max (98-00): Red=High Uncertainty, Blue=Low Uncertainty

Deviation from O3 2nd Max NAAQS (95-97): Red=Small Deviation, Blue=Large Deviation

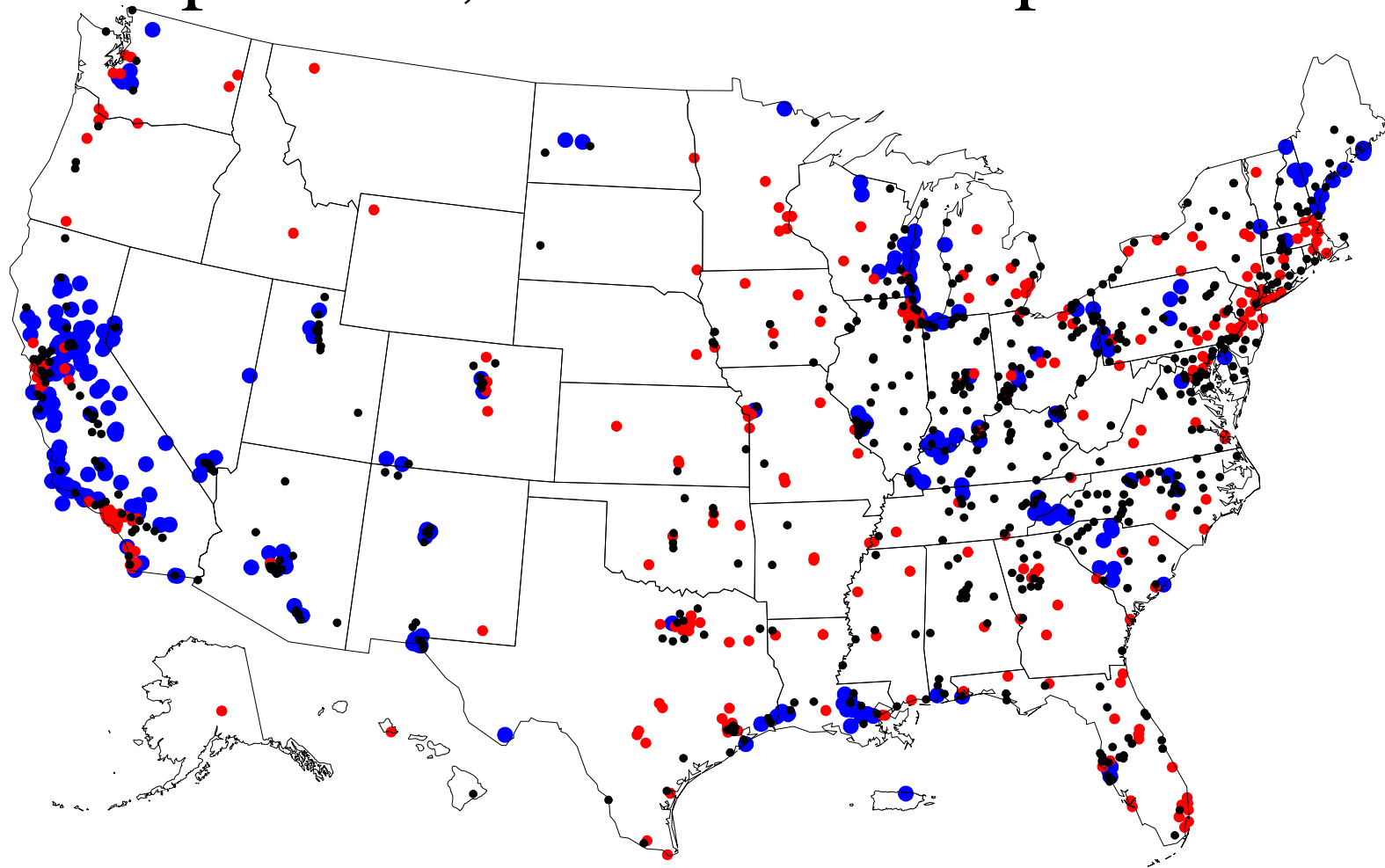Deviation from O3 2nd Max NAAQS (98-00): Red=Small Deviation, Blue=Large Deviation

Area for 1hr O3 Monitors:
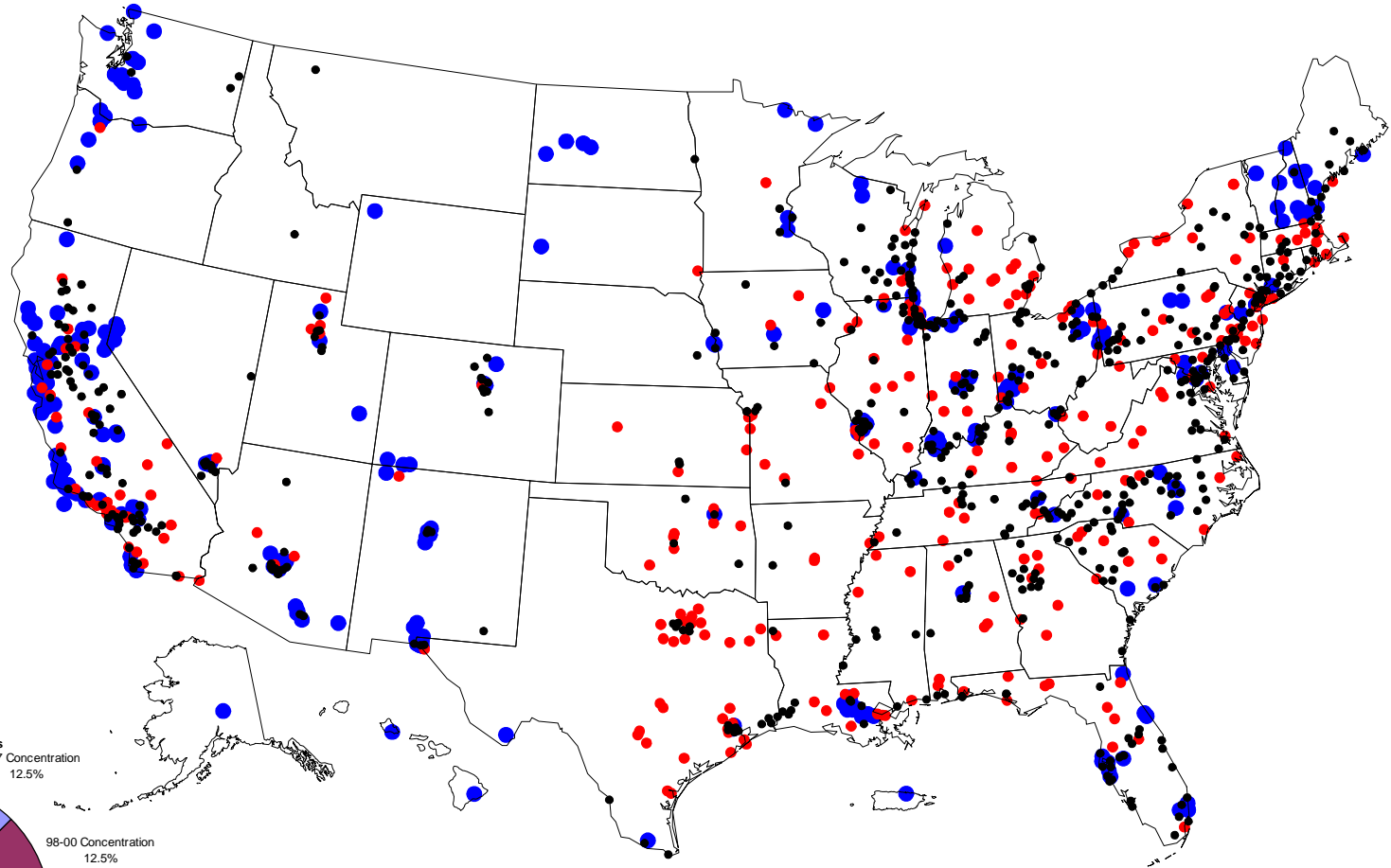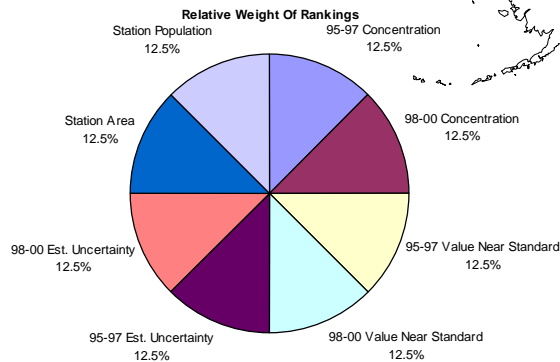Red=Large Area, Blue=Small Area
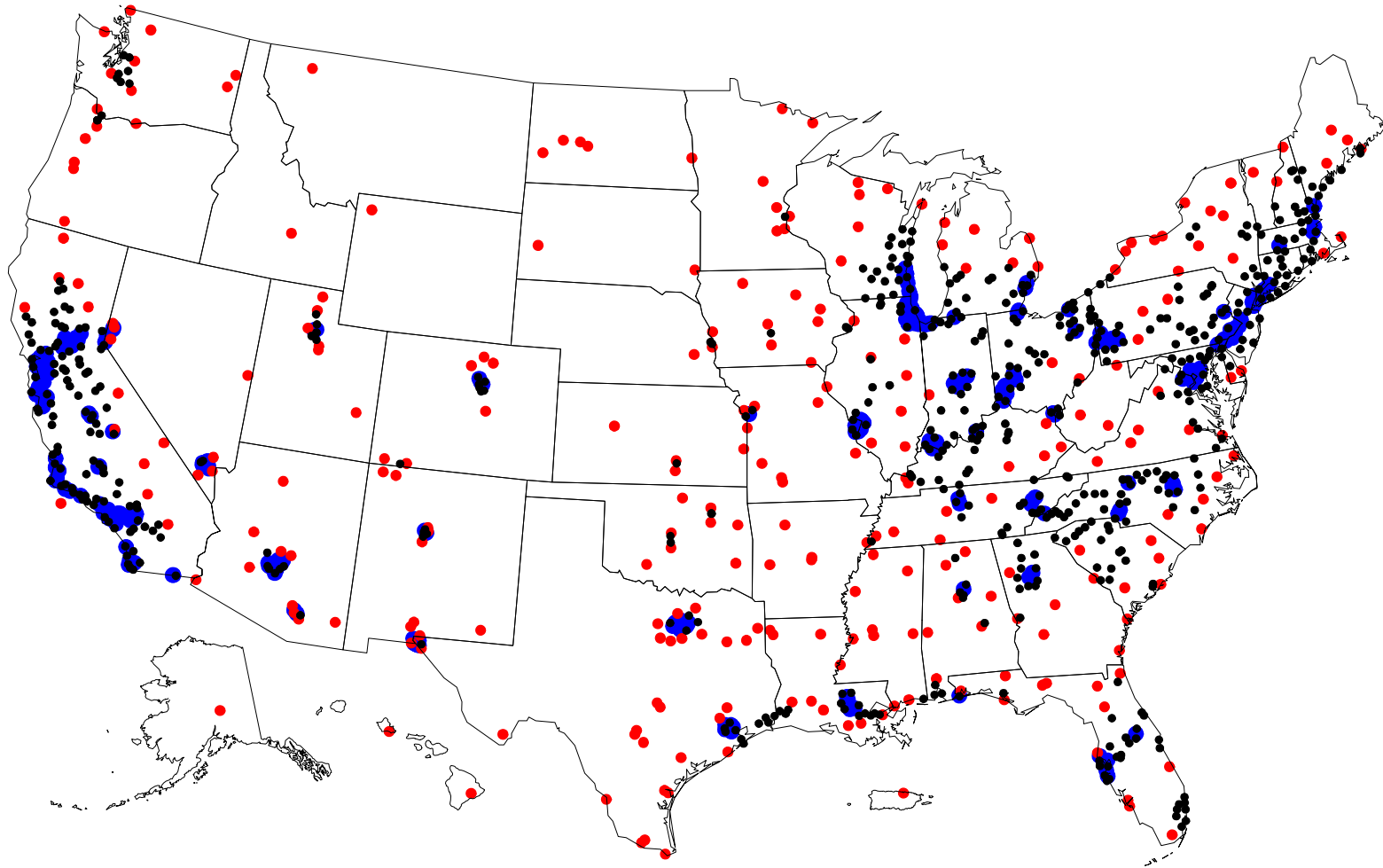
Population for 1hr O3 Monitors: Red=Large Population, Blue=Small Population

1-Hour O3 Aggregate Ranking Map:
Red=High Value, Blue=Low Value

1hr O3 Aggregate Ranking Map: Red=High Value, Blue=Low Value
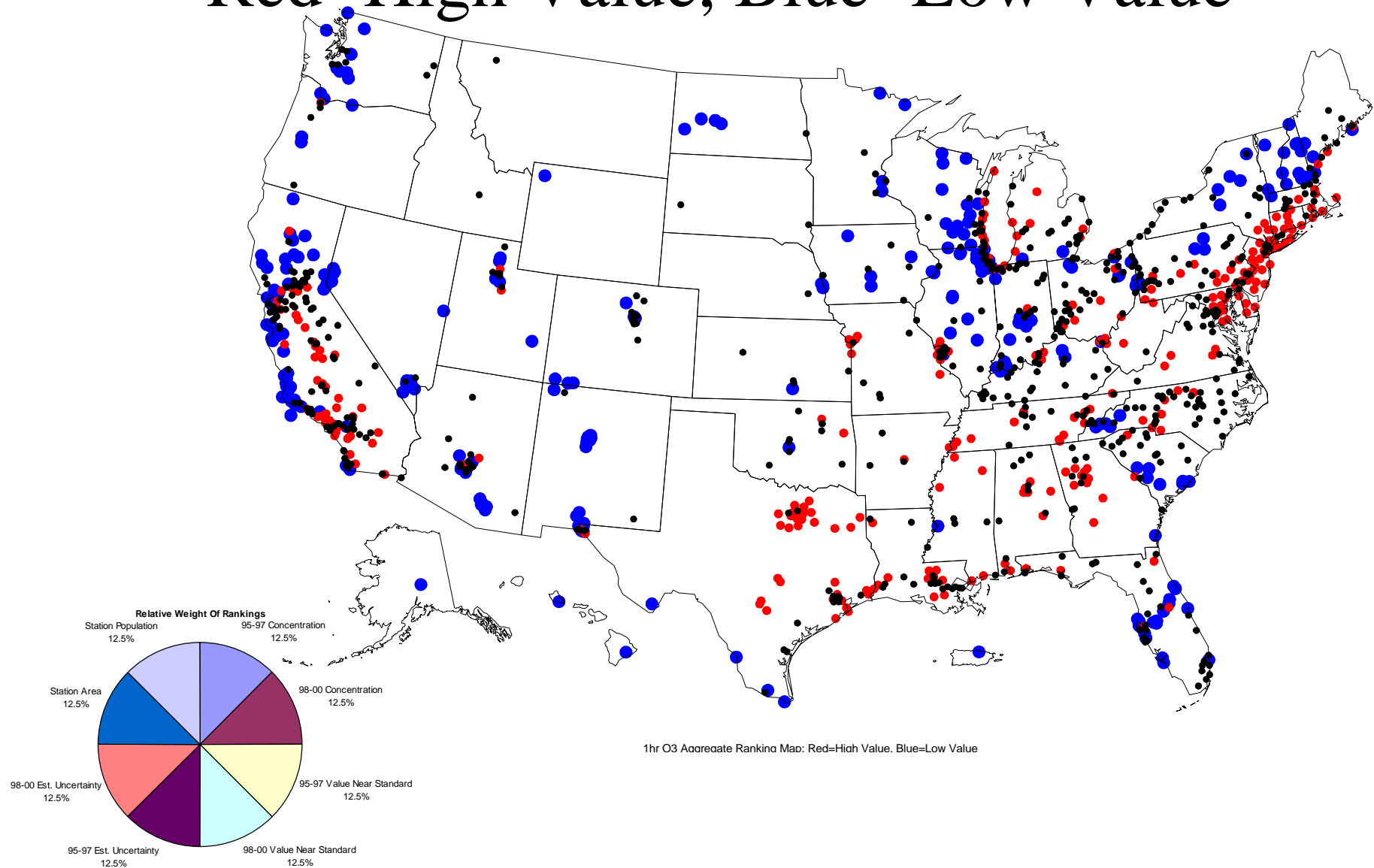
1-Hour O3 Quartiles

	1hr O3							
	o32x 95-97	o32x 98-00	o3error 95-97	o3error 98-00	dif_NAAQS_97	dif_NAAQS_00	area	population
Q1	0.115	0.114	0.0099	0.0093	0.009	0.009	7003.98	322552
Q3	0.093	0.094	0.0026	0.0024	0.029	0.0285	854.201	95079

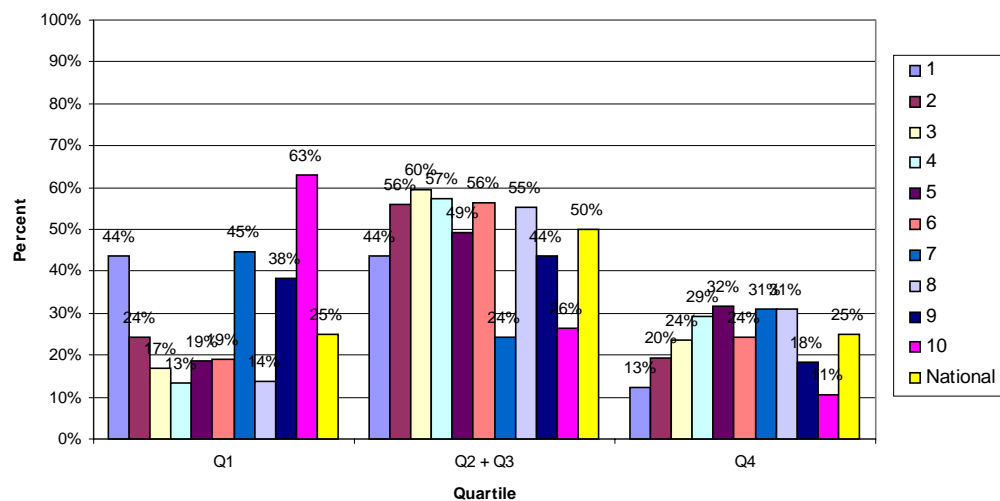# Regional Percent of Sites in National Quartiles


O3 1-Hour 2nd Max Concentration (95-97)
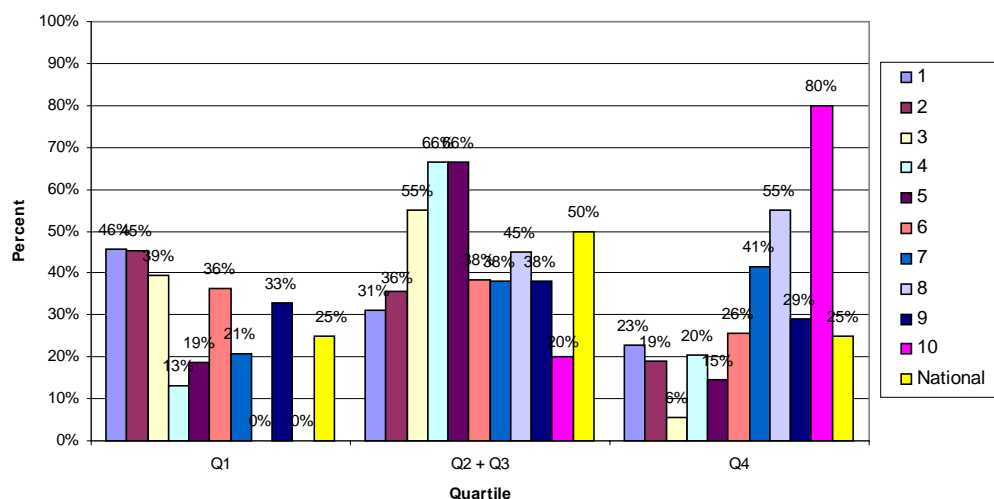
O3 1-Hour 2nd Max Concentration (98-00)
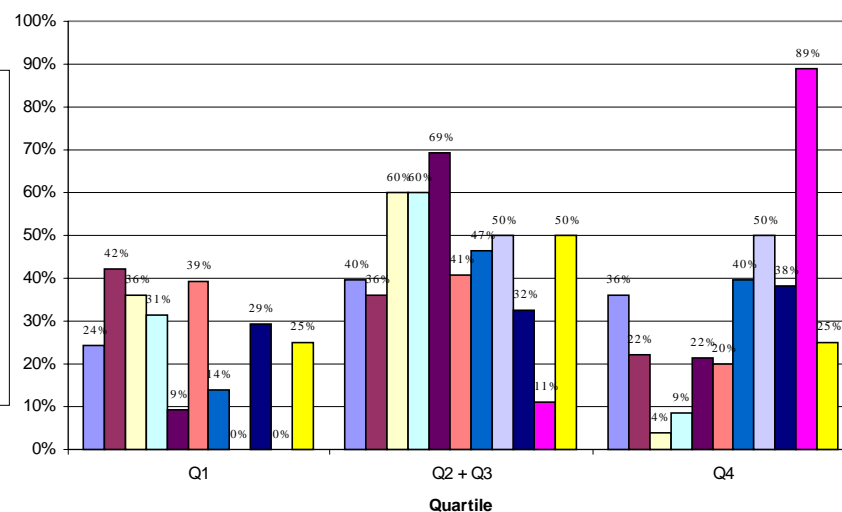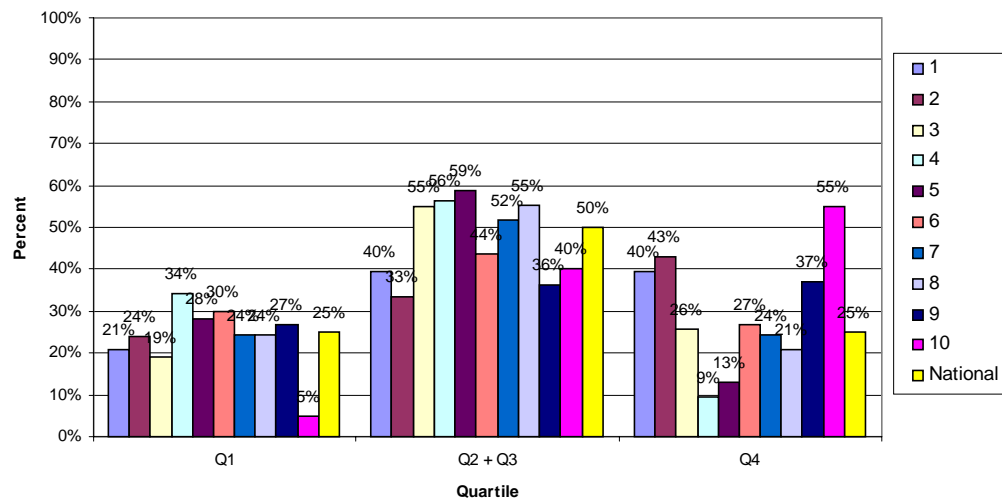
O3 1-Hour Uncertainty (95-97)
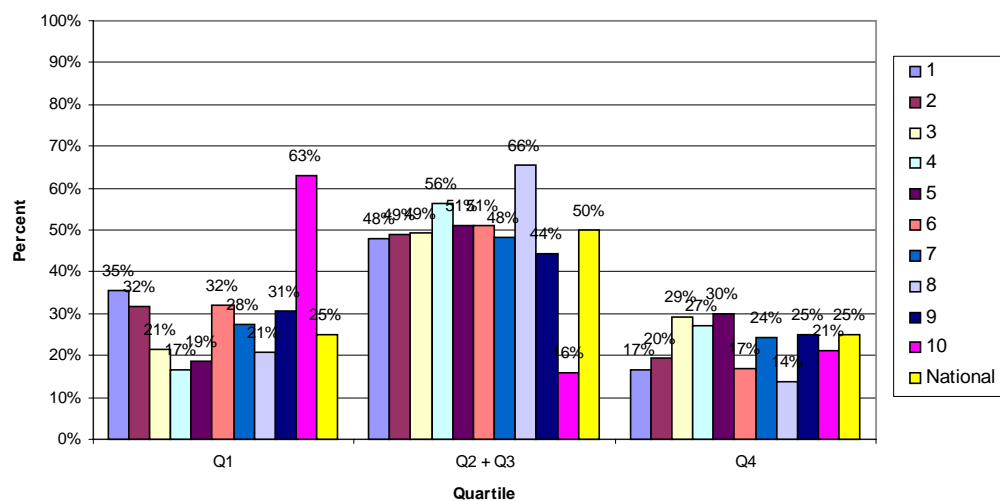
O3 1-Hour Uncertainty (98-00)
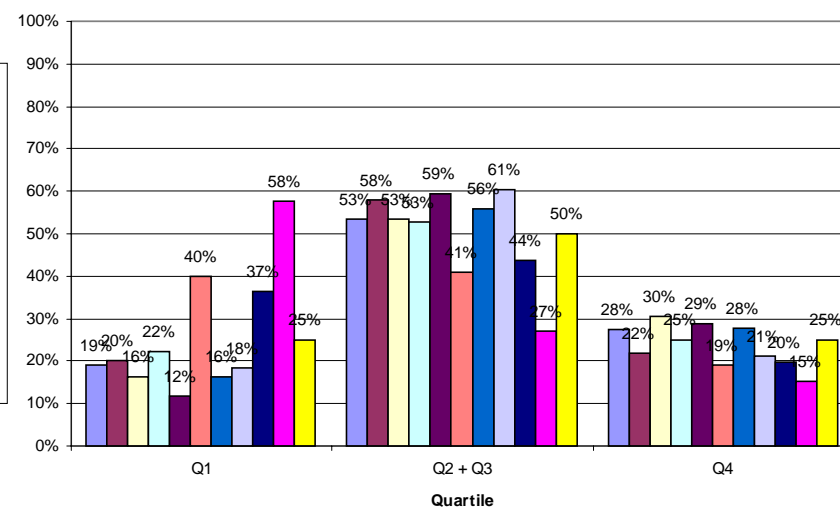
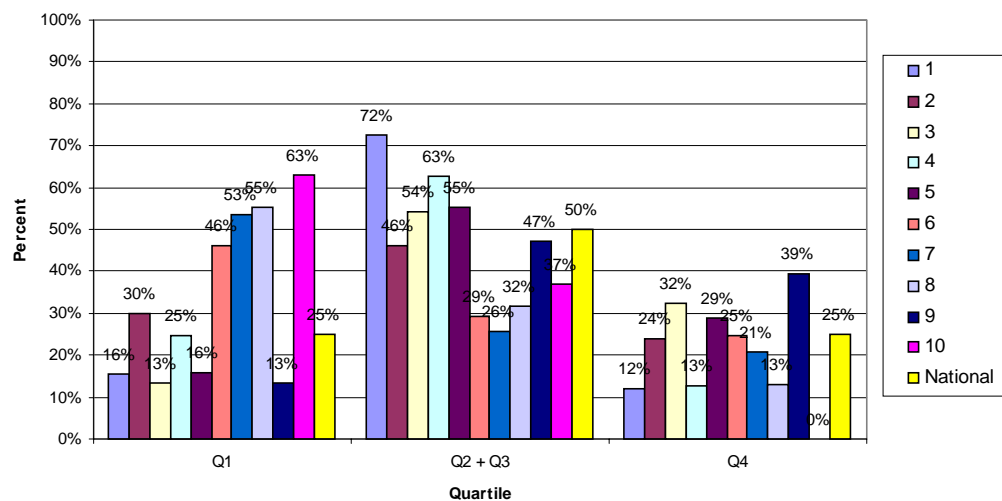# Regional Percent of Sites in National Quartiles



O3 1-Hour Deviation from NAAQS (95-97)
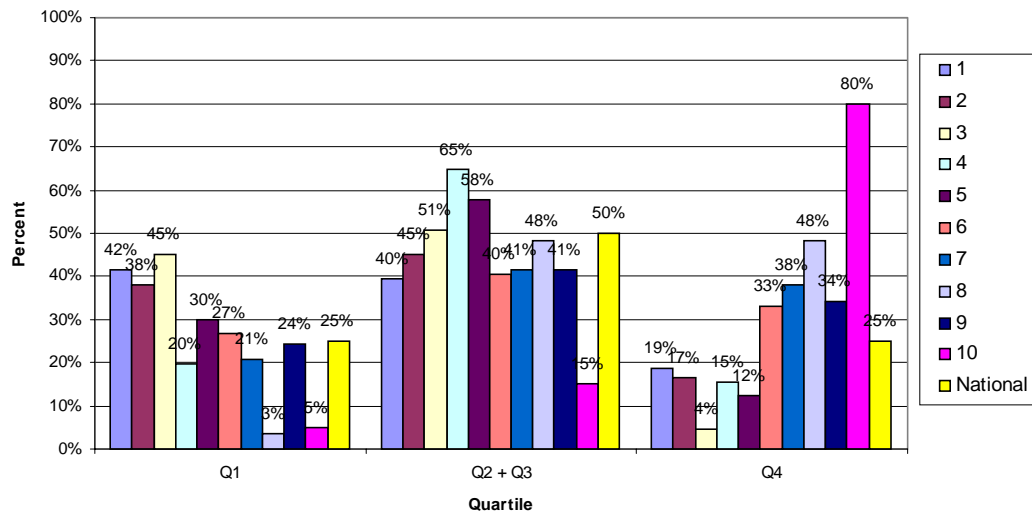

O3 1-Hour Deviation from NAAQS (98-00)
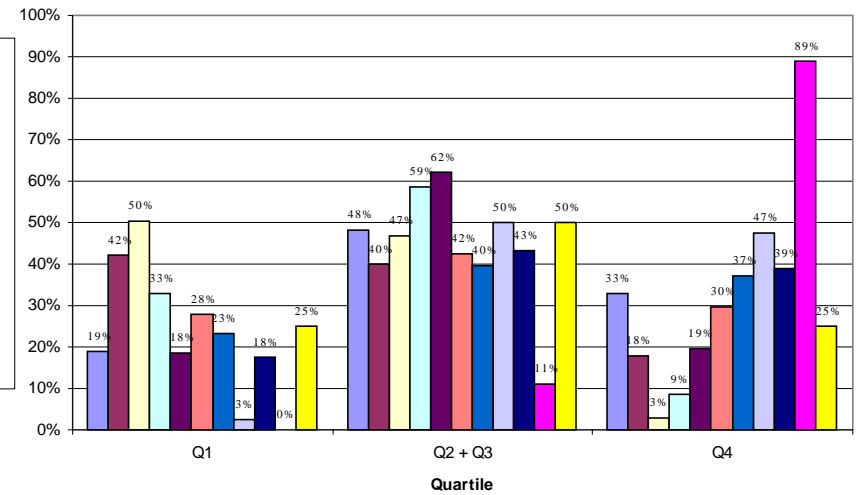
O3 1-Hour Area
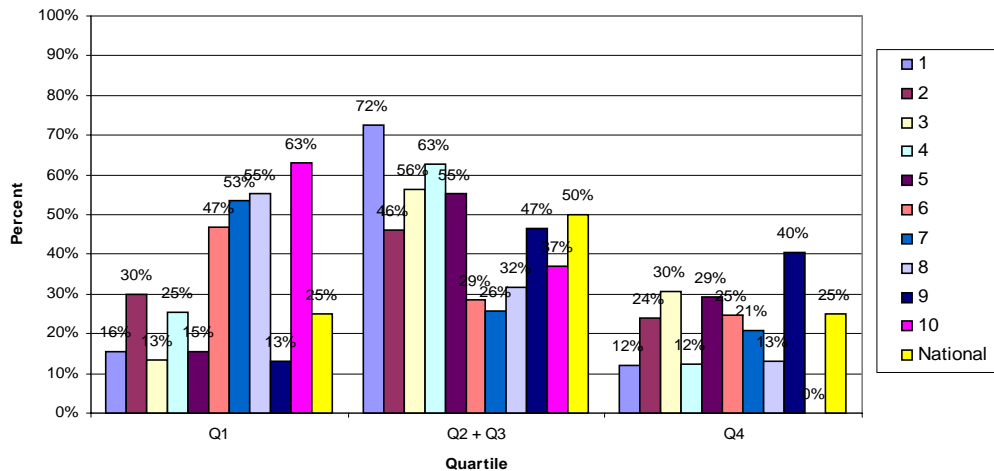
O3 1-Hour Population
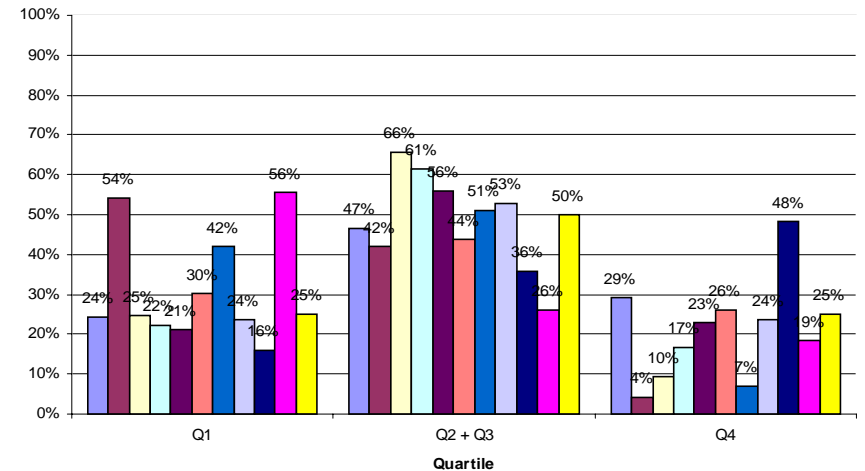
# Regional Percent of Sites in National Quartiles

O3 1-Hour Aggregate Data
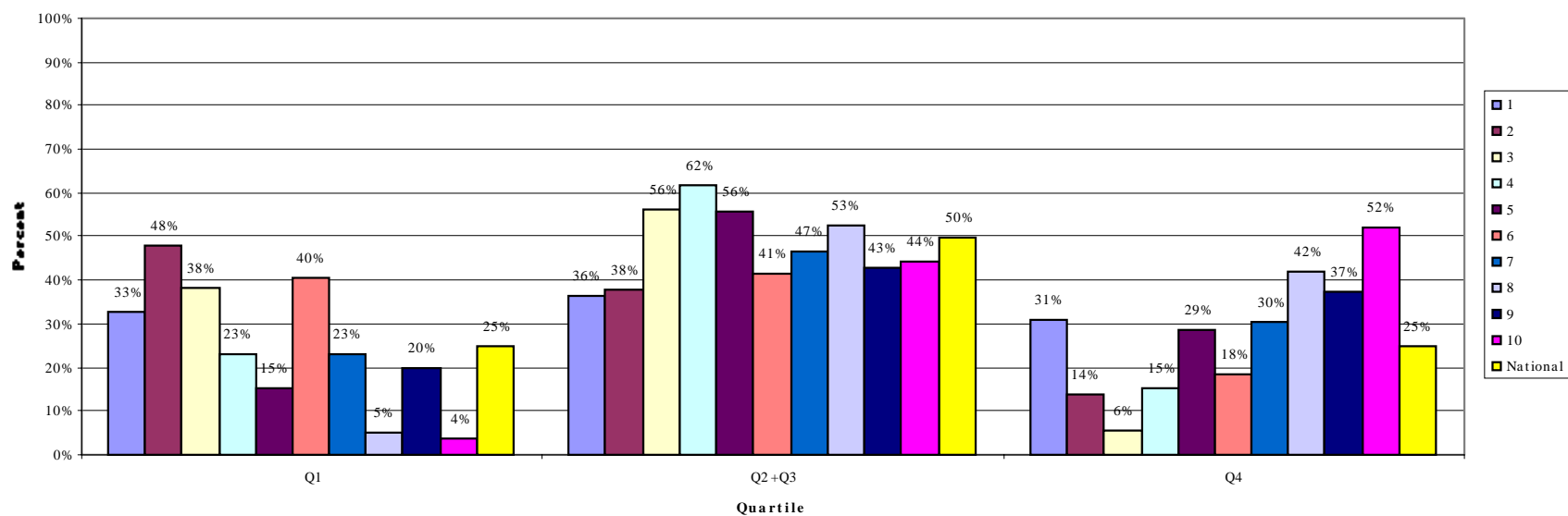
95-97 8-Hour O3 4th Max:
Red=Large Value, Blue=Small Value
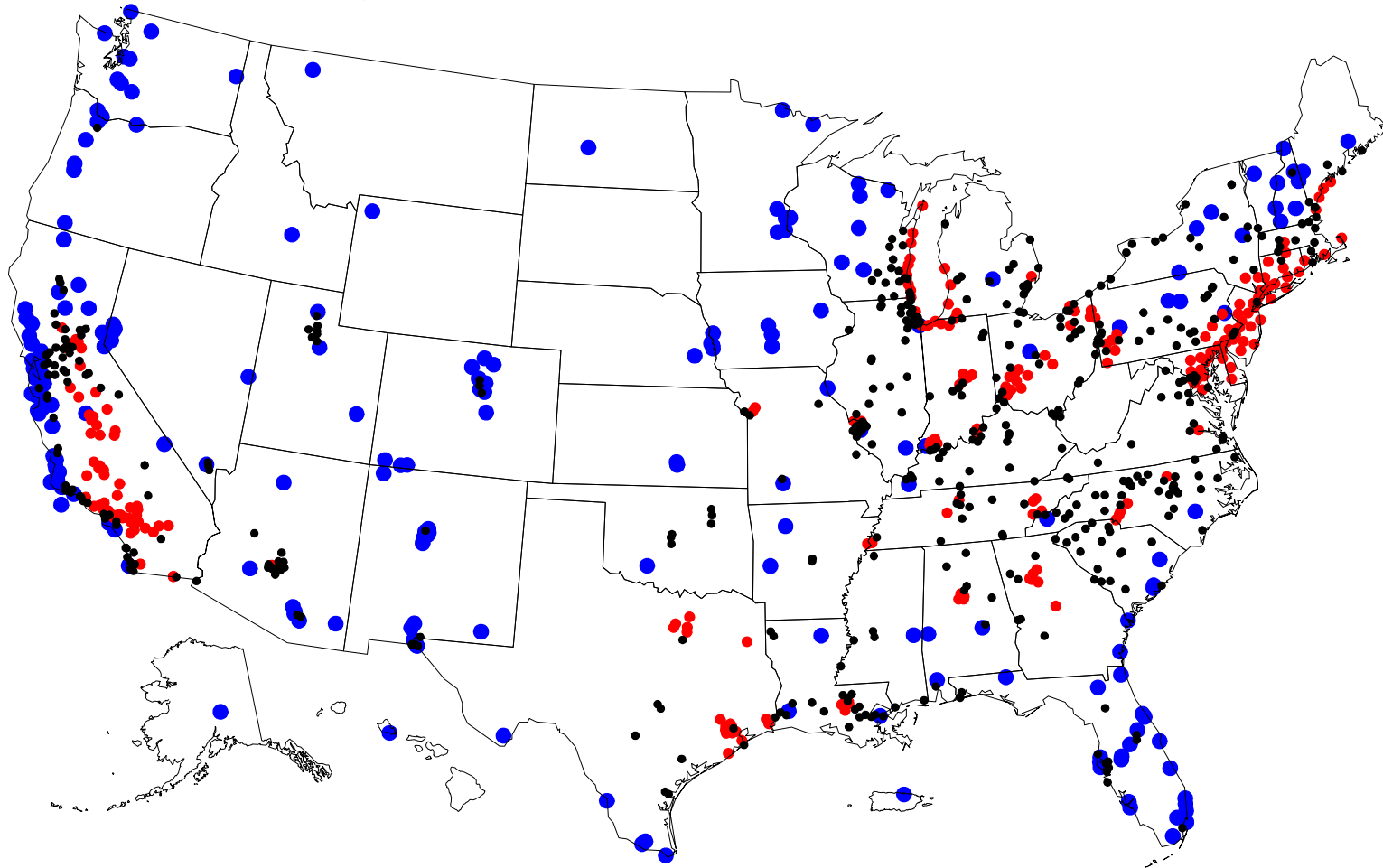
95-97 8hr O3 4th Max: Red=Large Value, Blue=Small Value

98-00 8-Hour O3 4th Max:
Red=Large Value, Blue=Small Value

98-00 8hr O3 4th Max: Red=Large Value. Blue=Small Value

Predicting 8hr O3 4th Max (95-97):
Red=High Uncertainty, Blue=Low Uncertainty

Predicting 8hr O3 4th Max (98-00):
Red=High Uncertainty, Blue=Low Uncertainty
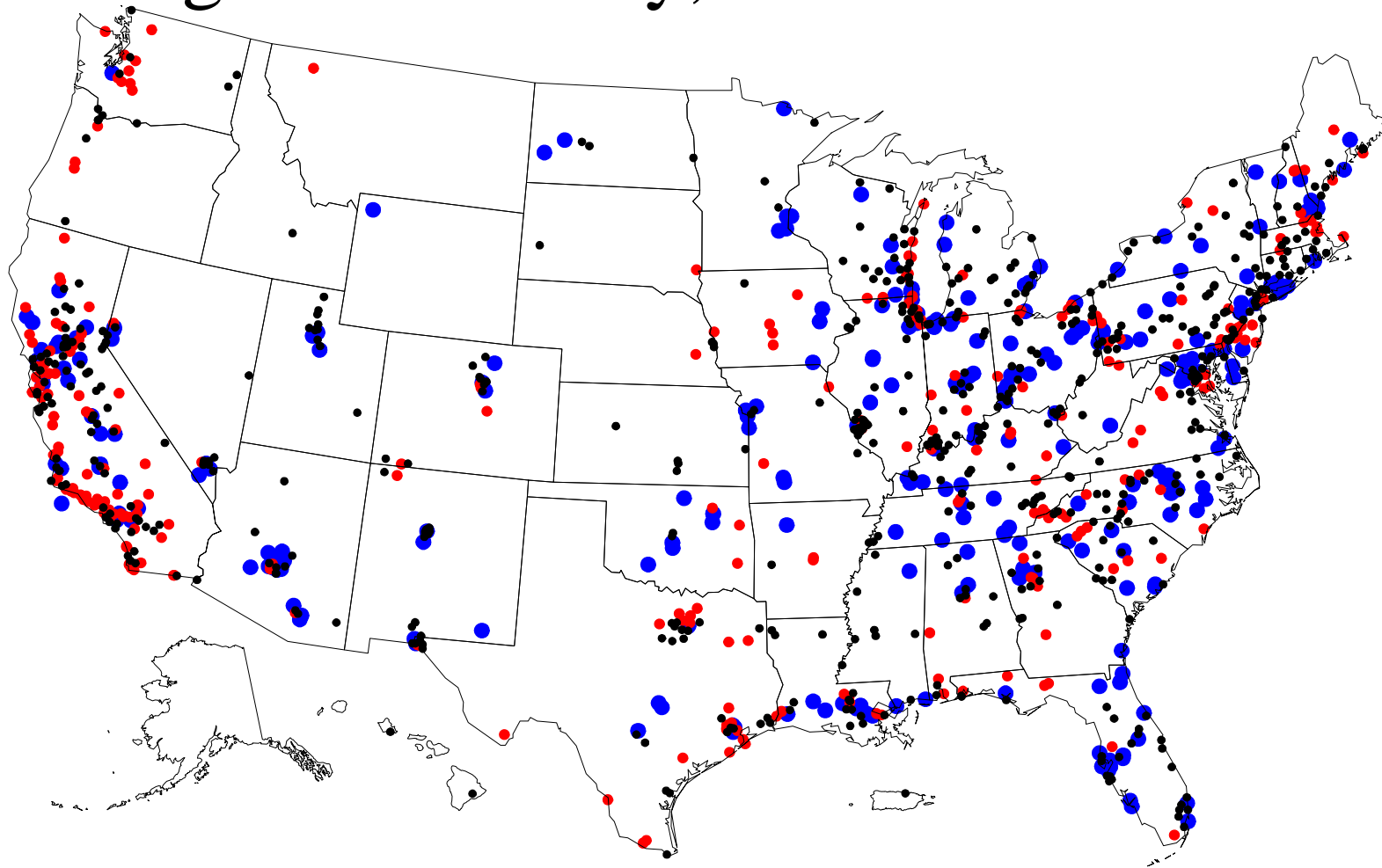
Predicting 8hr O3 4th Max (98-00): Red=High Uncertainty, Blue=Low Uncertainty

Deviation from O3 4th Max NAAQS (95-97): Red=Small Deviation, Blue=Large Deviation

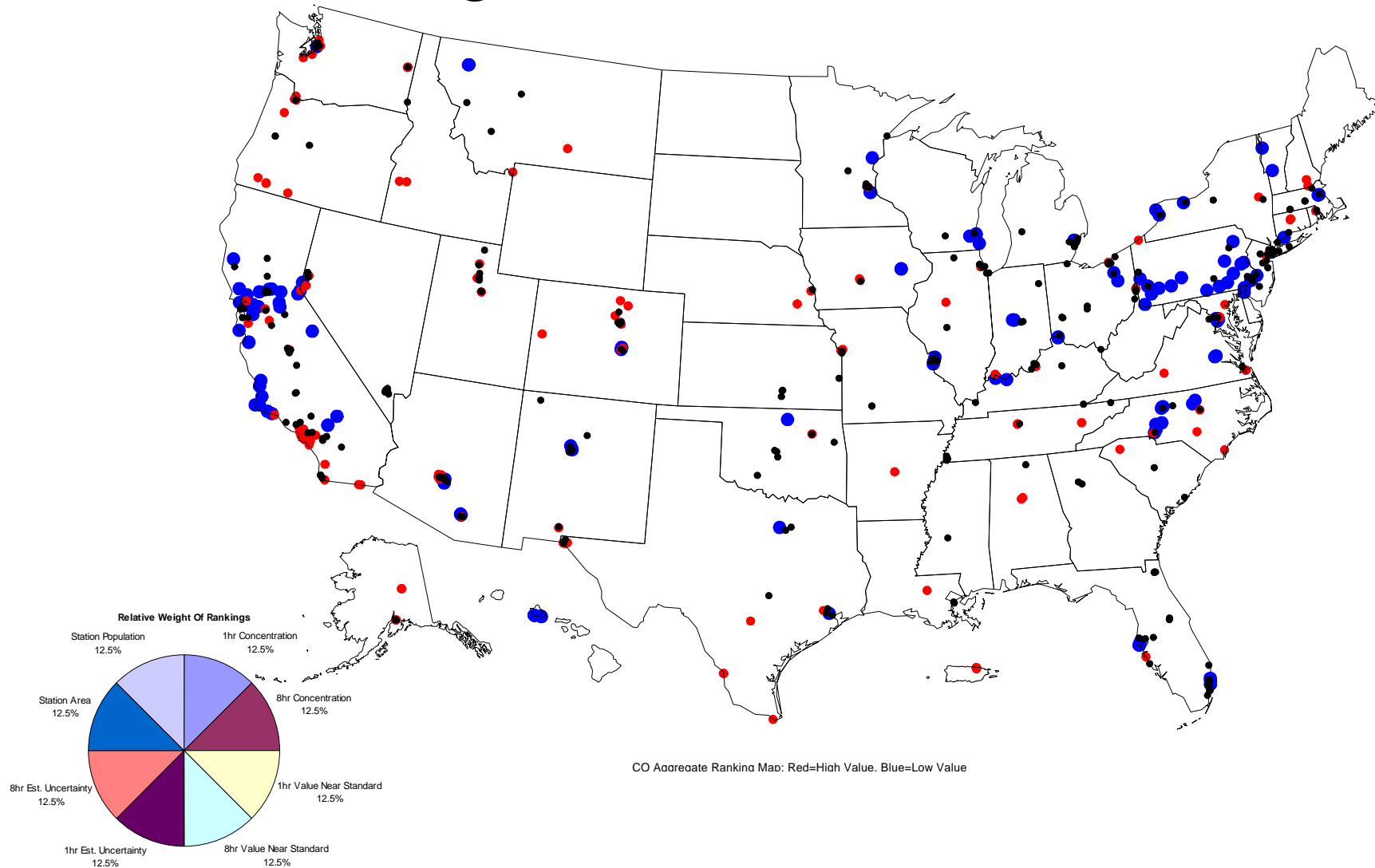Deviation from O3 4th Max NAAQS (98-00): Red=Small Deviation, Blue=Large Deviation

Area for 8hr O3 Monitors: Red=Large Area, Blue=Small Area

Population for 8hr O3 Monitors: Red=Large Population, Blue=Small Population

8-Hour O3 Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight Of Rankings

Station Population
12.5%

95-97 Concentration
12.5%

Station Area
12.5%

98-00 Concentration
12.5%

98-00 Est. Uncertainty
12.5%

95-97 Value Near Standard
12.5%

95-97 Est. Uncertainty
12.5%

98-00 Value Near Standard
12.5%

O3 8hr Aggregate Ranking Map: Red=High Value, Blue=Low Value

8-Hour O3

	8hr O3							
	o34x 95-97	o34x 98-00	o3error 95-97	o3error 98-00	dif_NAAQS_97	dif_NAAQS_00	area	population
Q1	0.091	0.091	0.0075	0.0067	0.004	0.004	6973.8	317204
Q3	0.075	0.076	0.0017	0.0017	0.014	0.014	862.806	95079

Regional Percent of Sites in National Quartiles

O3 8-Hour 2nd Max Concentration (95-97)
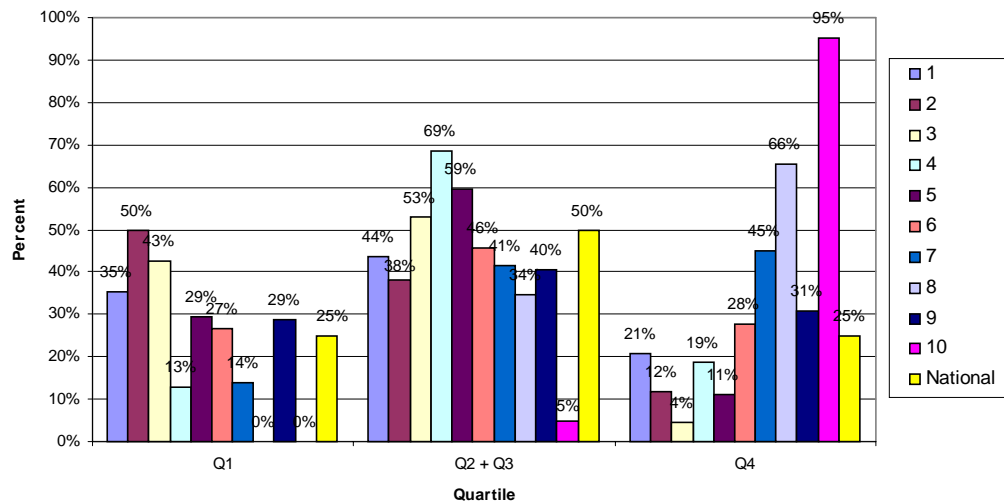
O3 8-Hour 2nd Max Concentration (98-00)
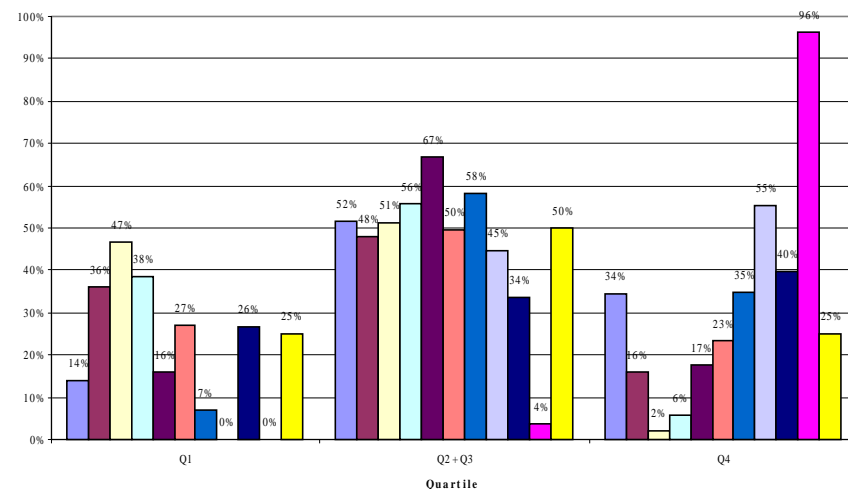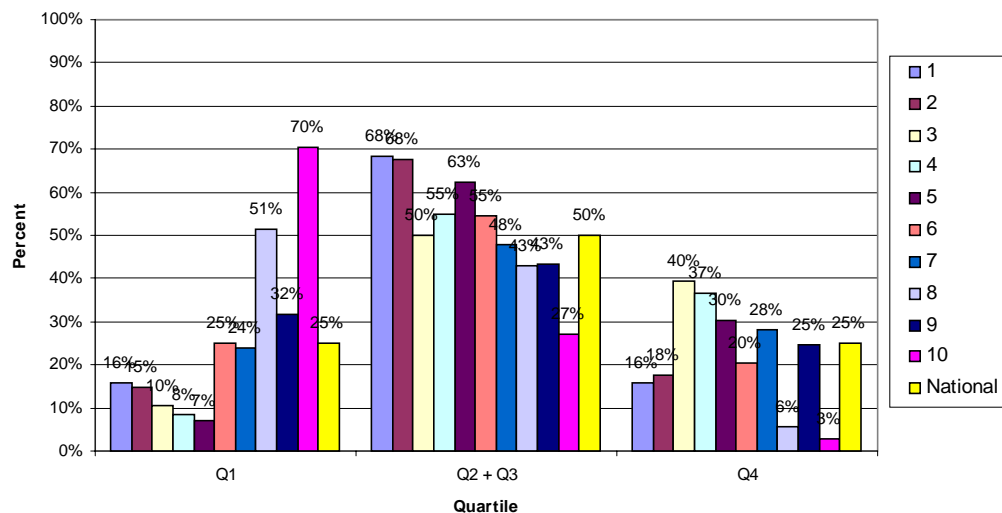
O3 8-Hour Uncertainty (95-97)

O3 8-Hour Uncertainty (98-00)
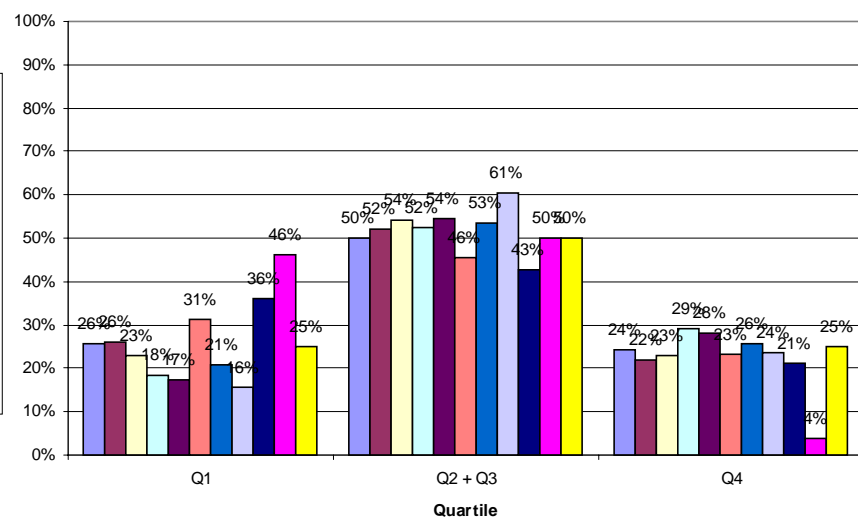
Regional Percent of Sites in National Quartiles

O3 8-Hour Deviation from NAAQS (95-97)


O3 8-Hour Deviation from NAAQS (98-00)
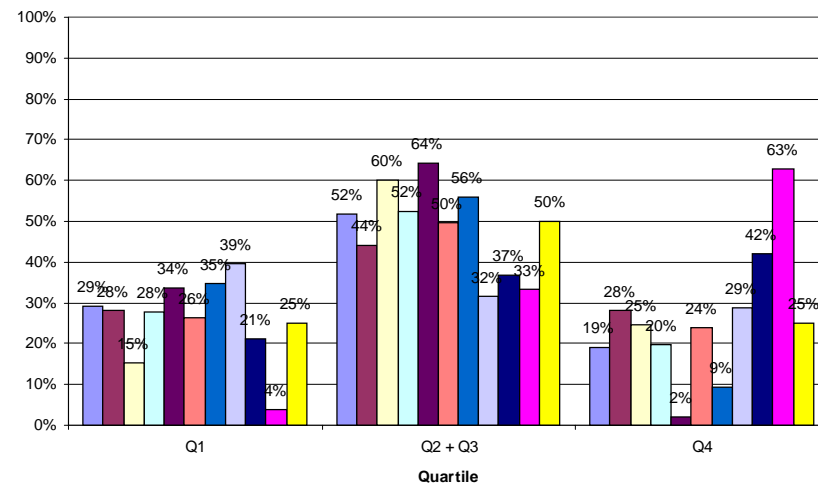
O3 8-Hour Area

O3 8-Hour Population
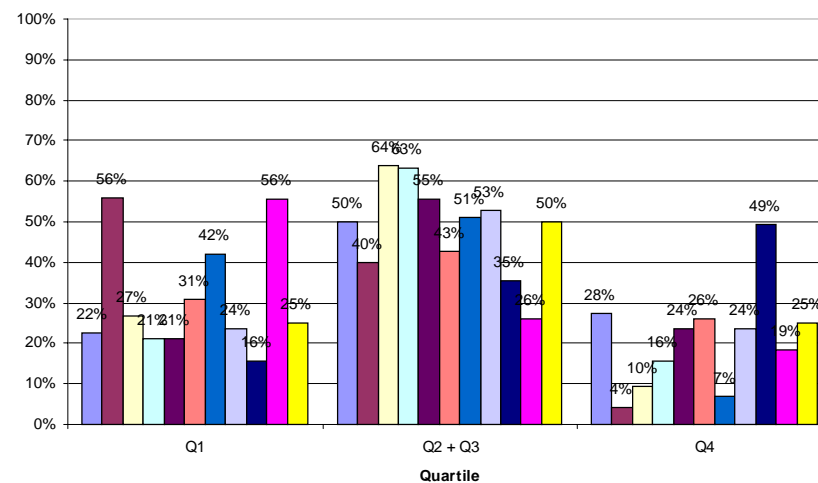
Regional Percent of Sites in National Quartiles

O3 8-Hour Aggregate Data
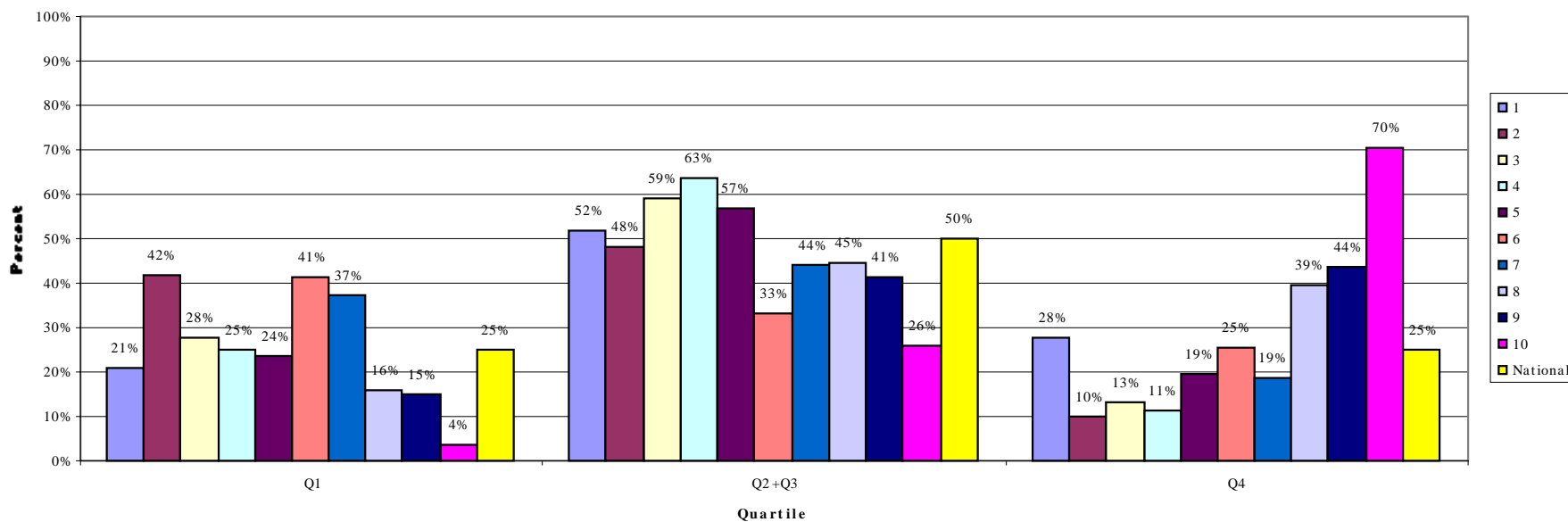
8-Hour CO 2nd Max:
Red=Large Value, Blue=Small Value
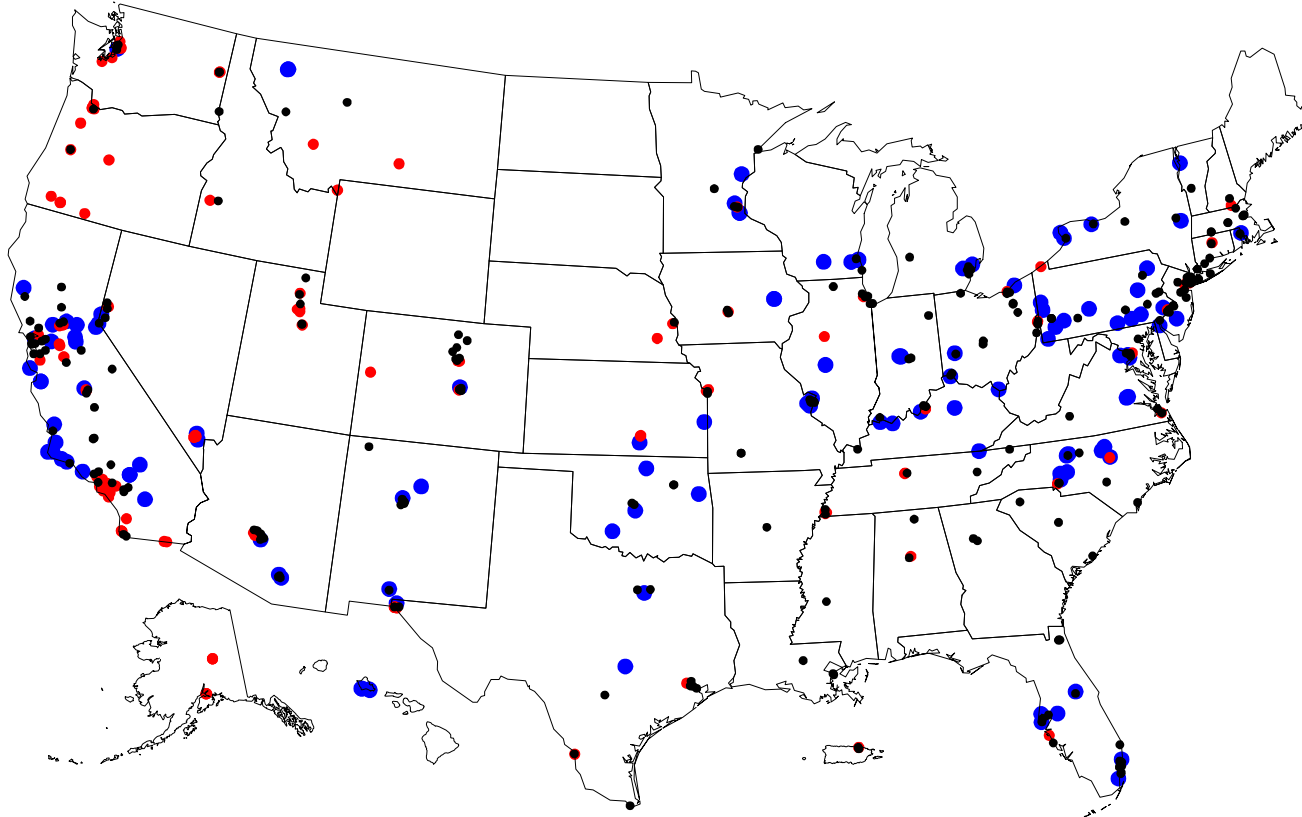
8-Hour CO 2nd Max: Red=Large Value, Blue=Small Value

1-Hour CO 2nd Max:
Red=Large Value, Blue=Small Value
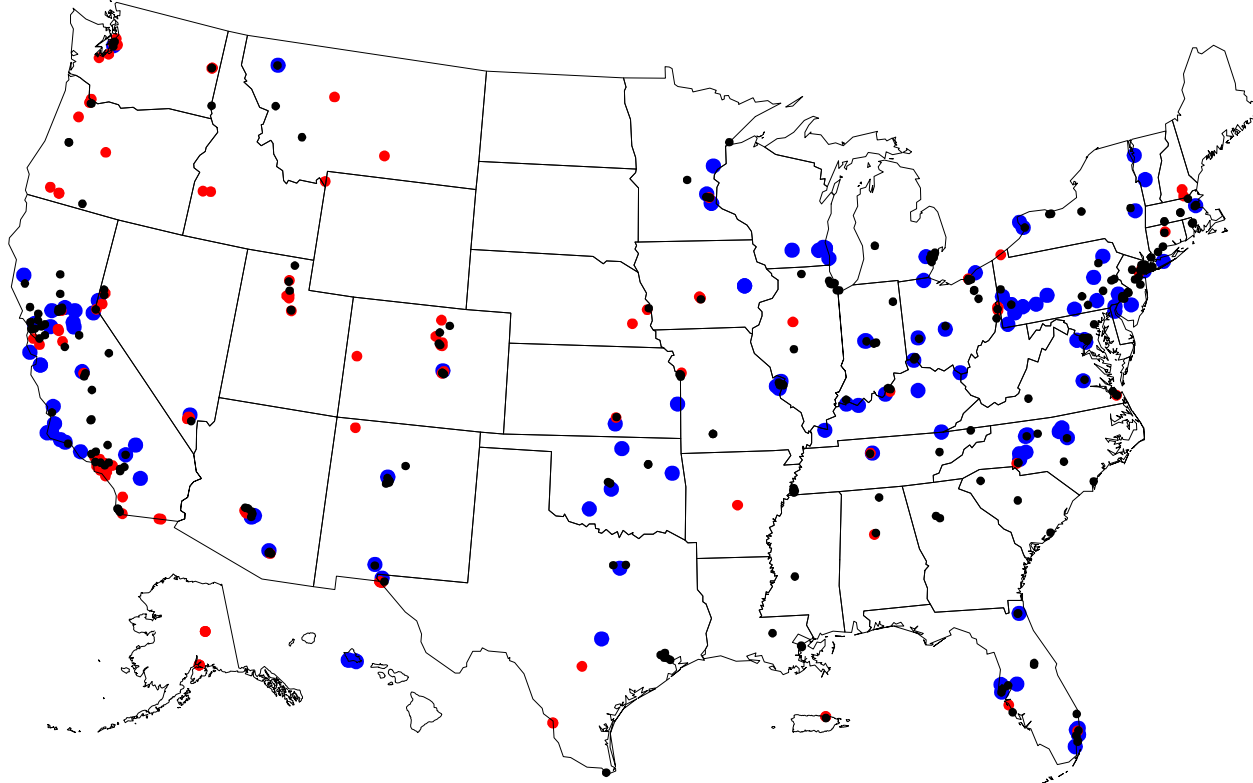
1-Hour CO 2nd Max: Red=Large Value, Blue=Small Value

Predicting 8-Hour CO 2nd Max:
Red=High Uncertainty, Blue=Low Uncertainty
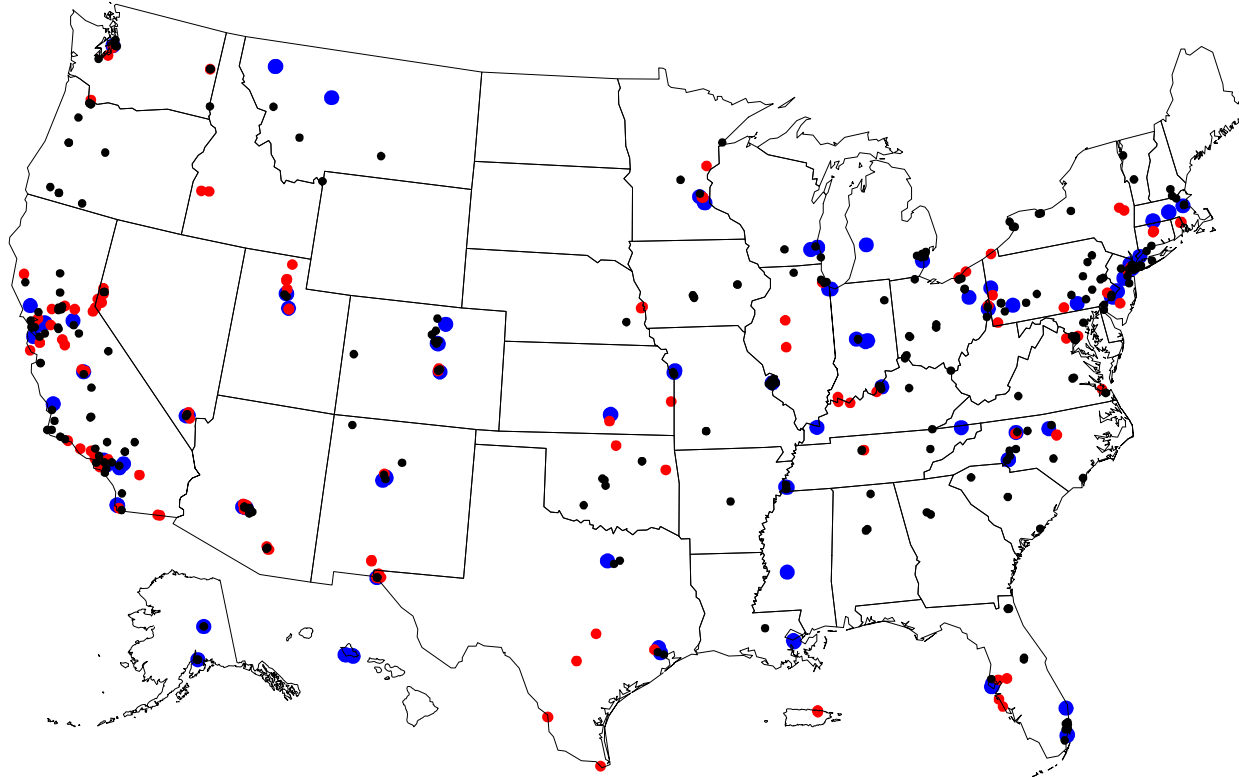
Predicting 8-Hour CO 2nd Max: Red=High Uncertainty, Blue=Low Uncertainty

Predicting 1-Hour CO 2nd Max:
# Red=High Uncertainty, Blue=Low Uncertainty
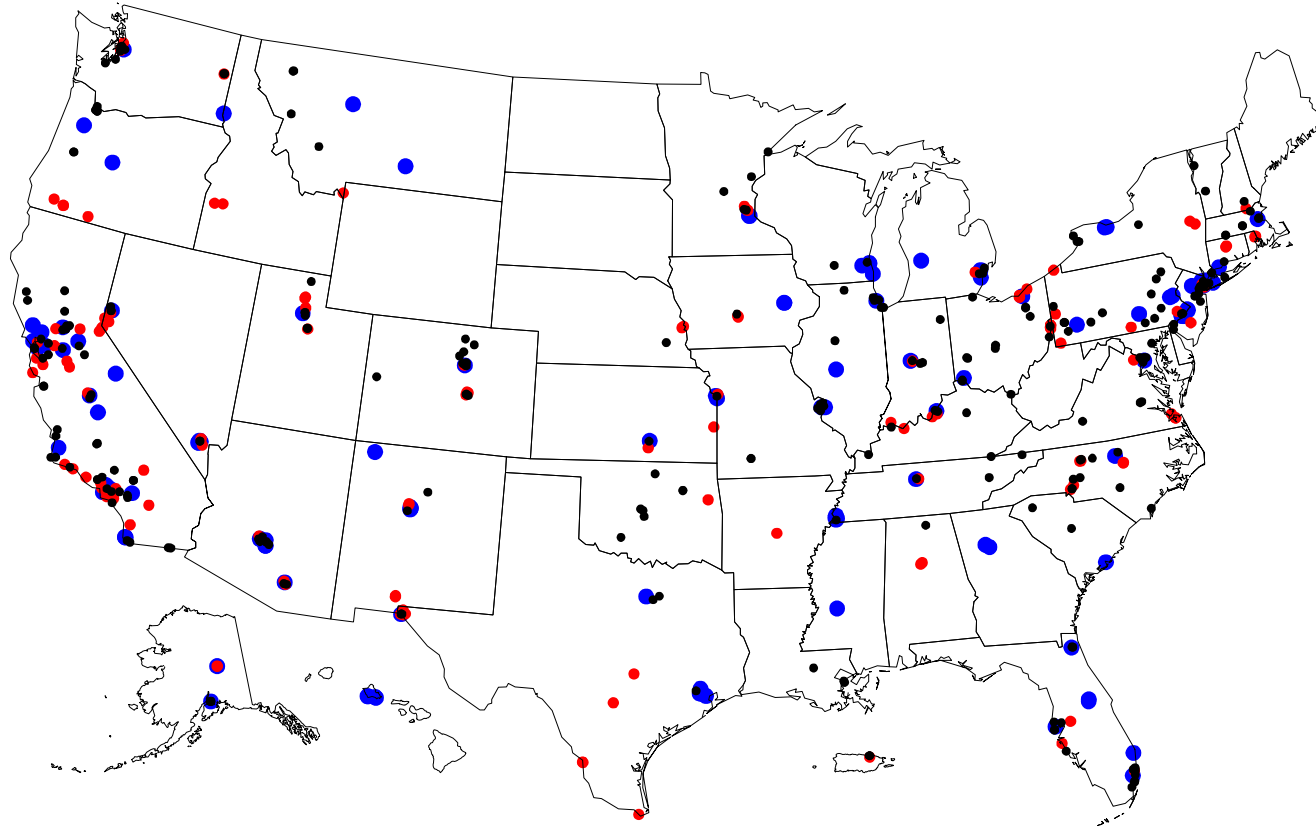
Predicting 1-Hour CO 2nd Max: Red=High Uncertainty, Blue=Low Uncertainty

Deviation from 8-Hour CO NAAQS:
Red=Small Deviation, Blue=Large Deviation
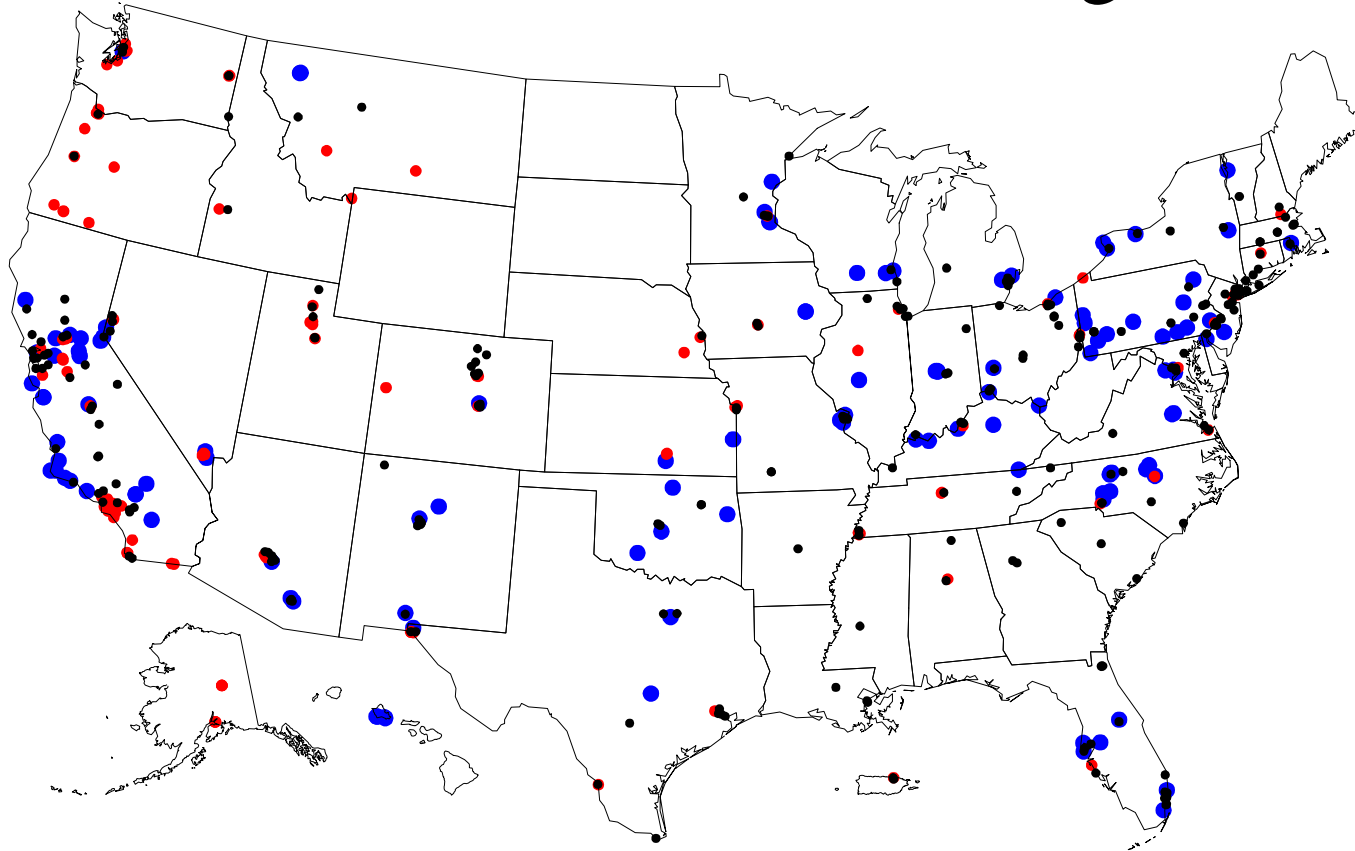
Deviation from 8-Hour CO NAAQS: Red=Small Deviation, Blue=Large Deviation

Deviation from 1-Hour CO NAAQS:
# Red=Small Deviation, Blue=Large Deviation
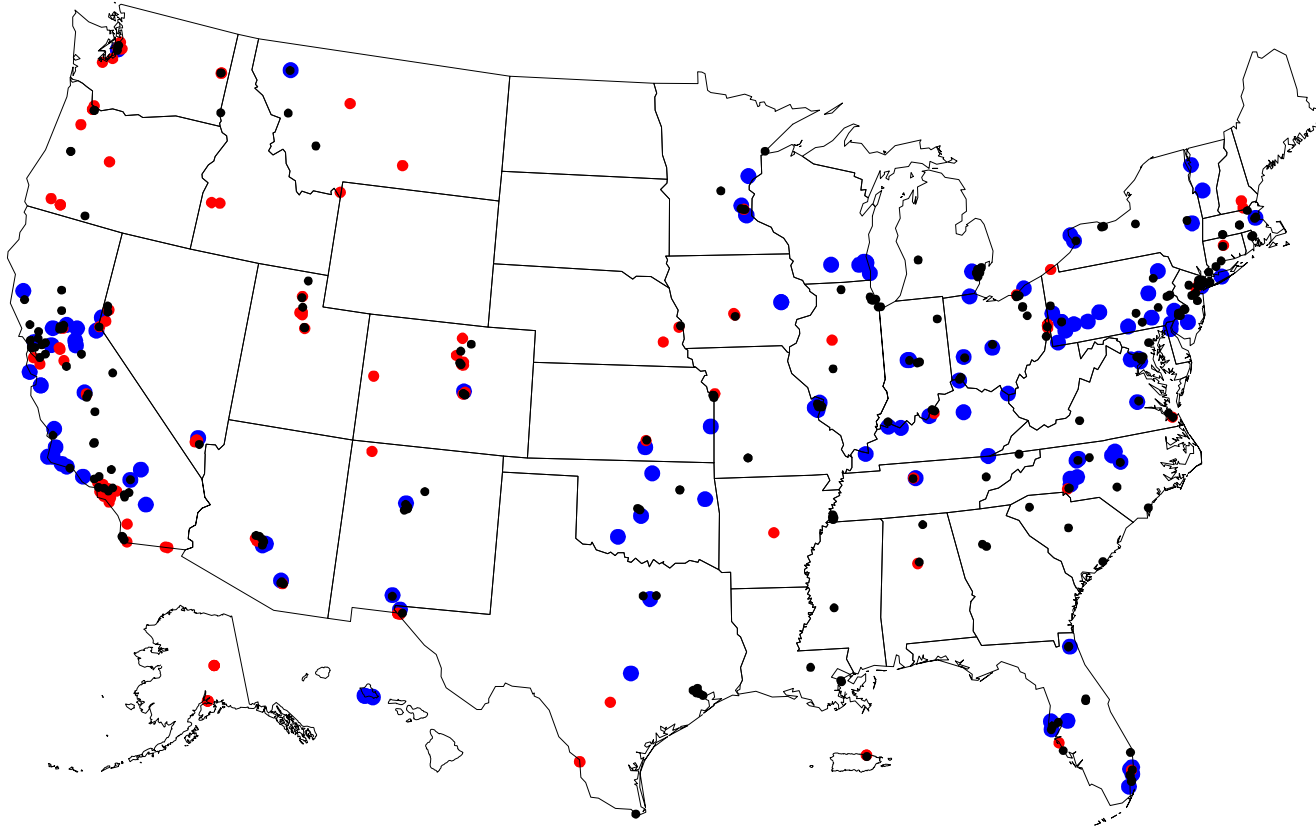
Deviation from 1-Hour CO NAAQS: Red=Small Deviation, Blue=Large Deviation

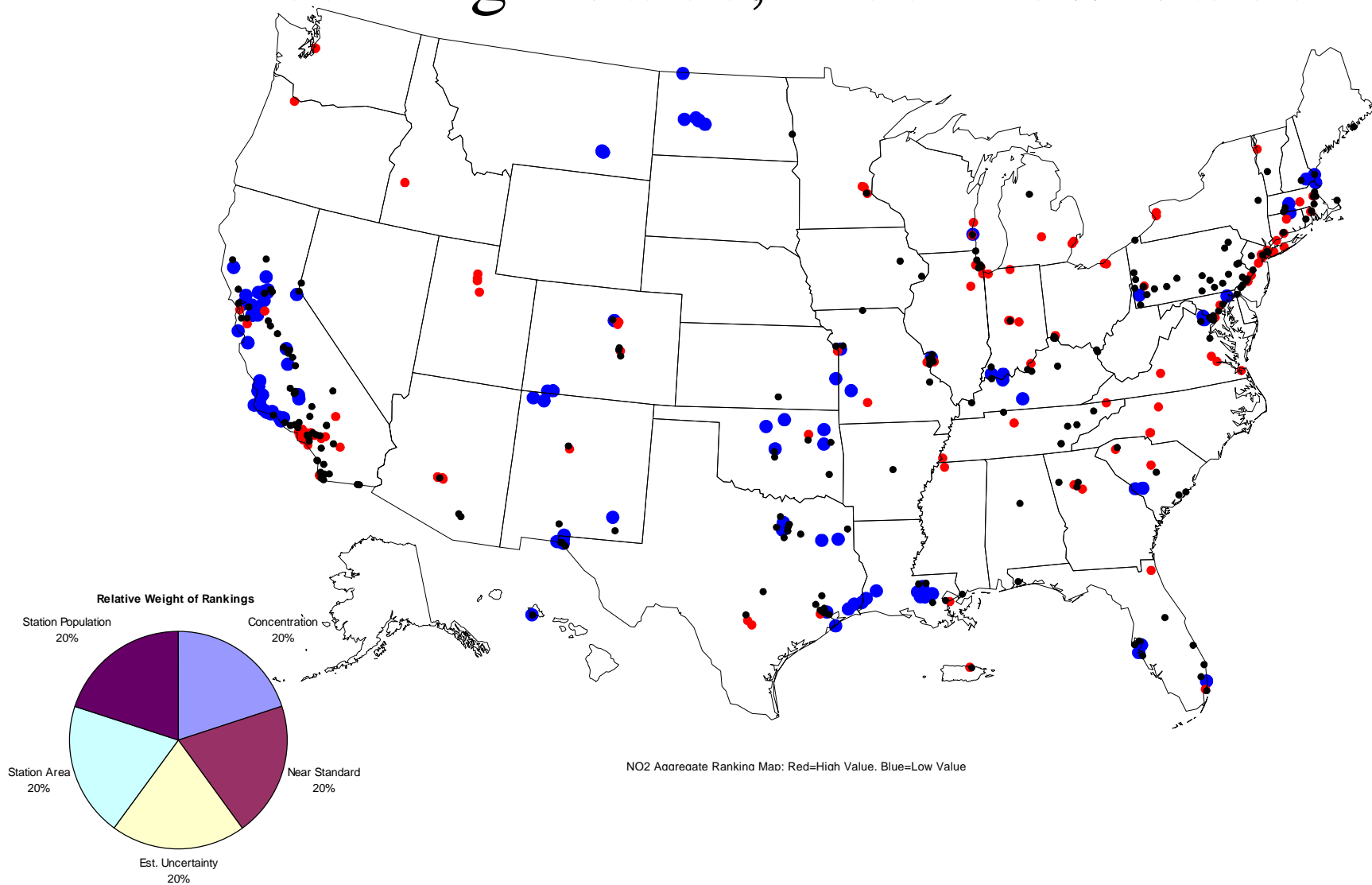# Area for CO Monitors:
Red=Large Area, Blue=Small Area
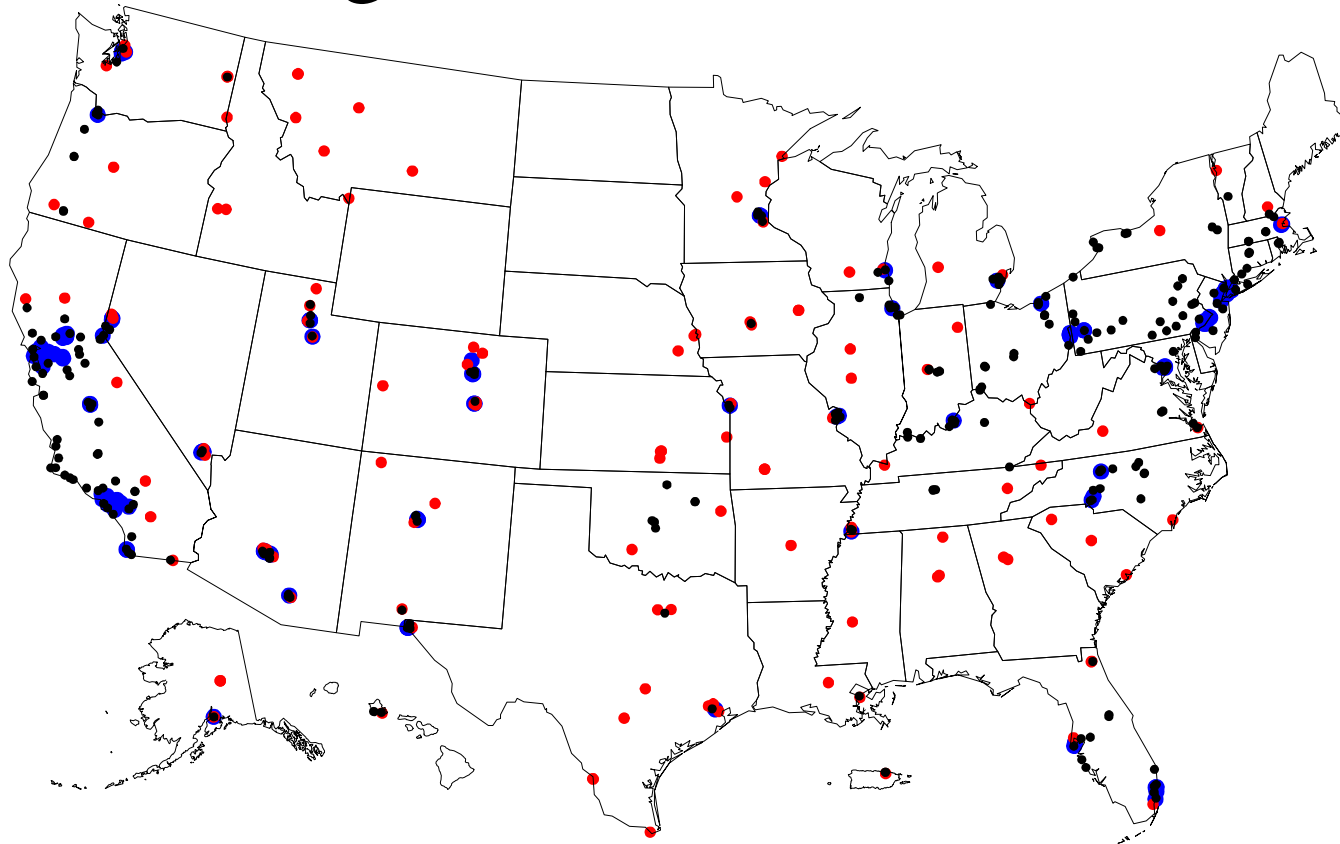
Area for CO Monitors: Red=Large Area, Blue=Small Area

Population for CO Monitors: Red=Large Population, Blue=Small Population

# CO Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight Of Rankings

Station Population
12.5%

1hr Concentration
12.5%

Station Area
12.5%

8hr Concentration
12.5%

8hr Est. Uncertainty
12.5%

1hr Value Near Standard
12.5%

1hr Est. Uncertainty
12.5%

8hr Value Near Standard
12.5%

CO Aggregate Ranking Map: Red=High Value, Blue=Low Value

CO Quartiles

	co1hr2x	co8hr2x	co1hrerr	co8hrerr	dif_NAAQS_8hr	dif_NAAQS_1hr	area	population
Q1	7.1	4.4	2.5	1.5	4.6	27.9	21400	787498
Q3	4	2.4	0.7	0.3	6.6	31	1420	179997

Regional Percent of Sites in National Quartiles

CO 1-Hour Concentration
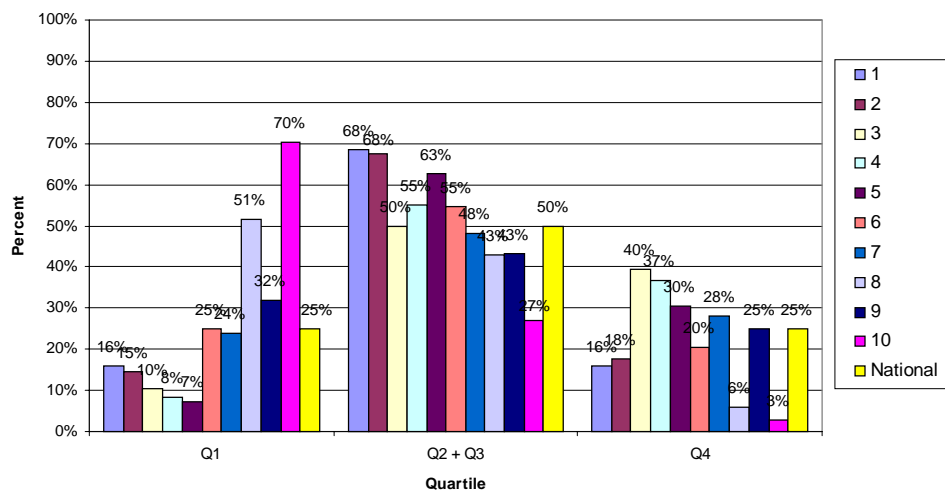
CO 8-Hour Concentration
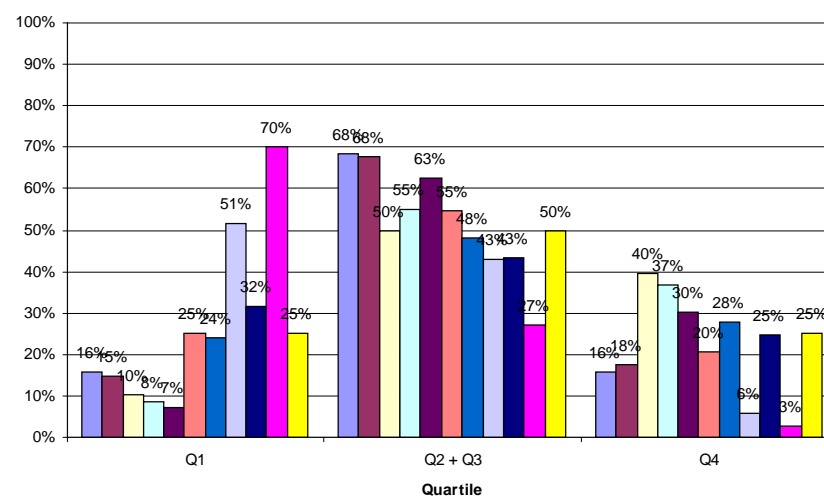
CO 1-Hour Uncertainty
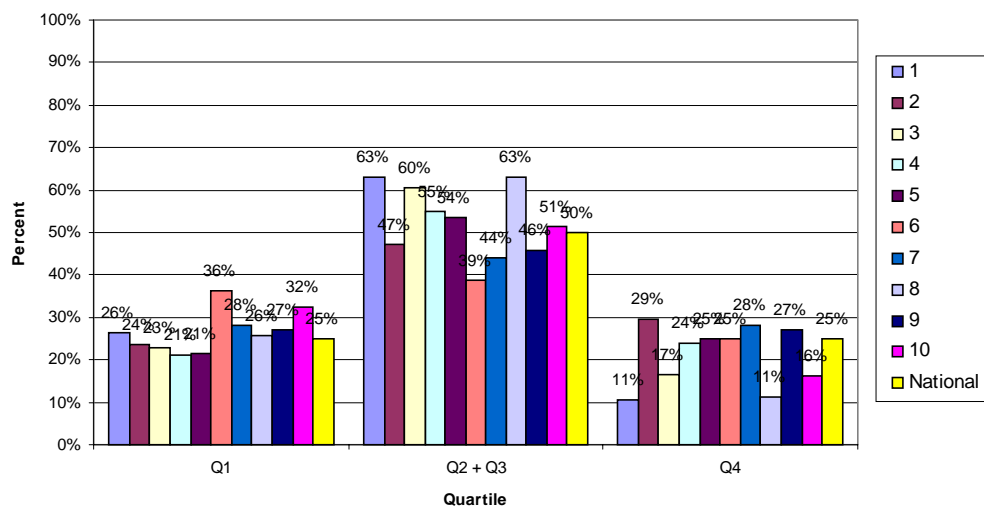
CO 1-Hour Uncertainty
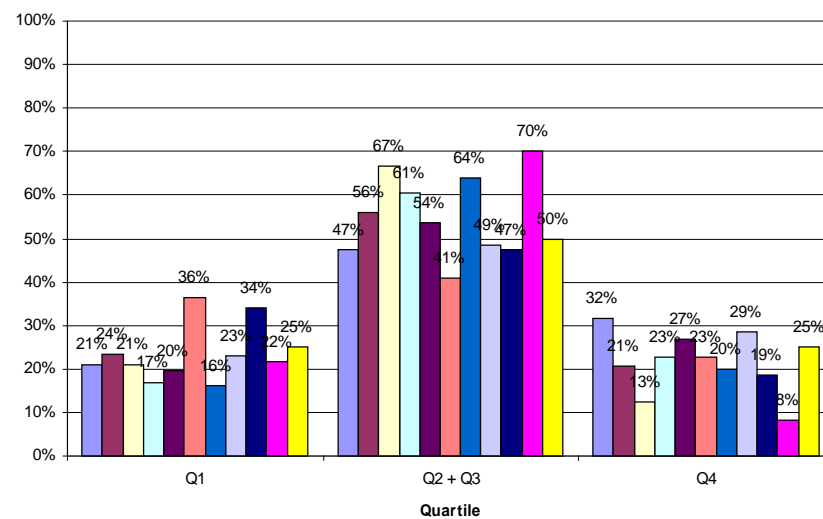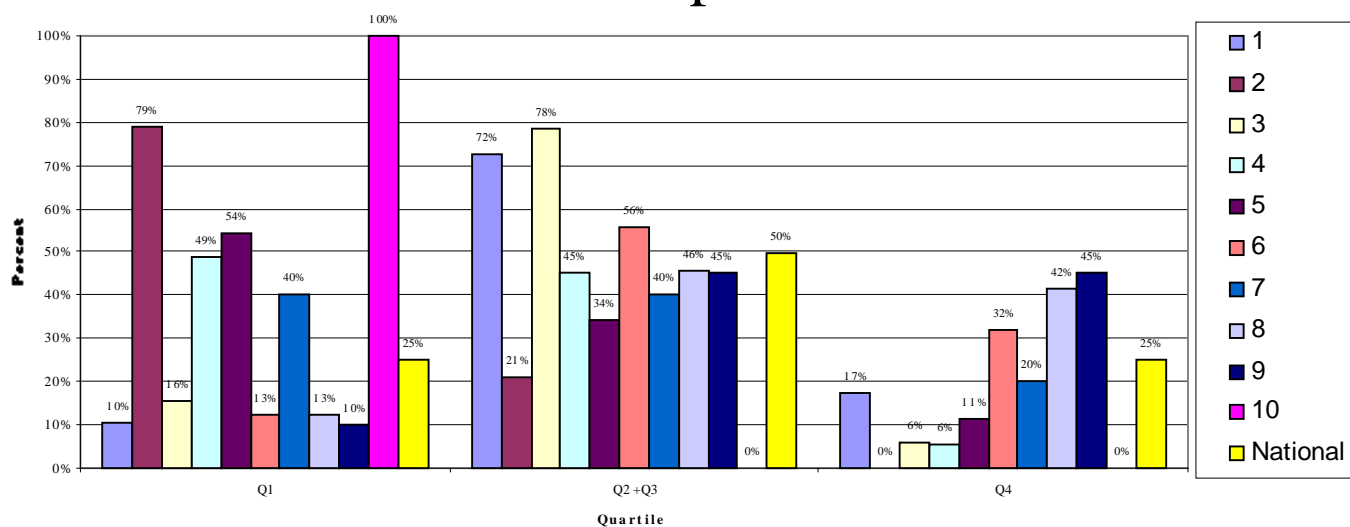
Regional Percent of Sites in National Quartiles
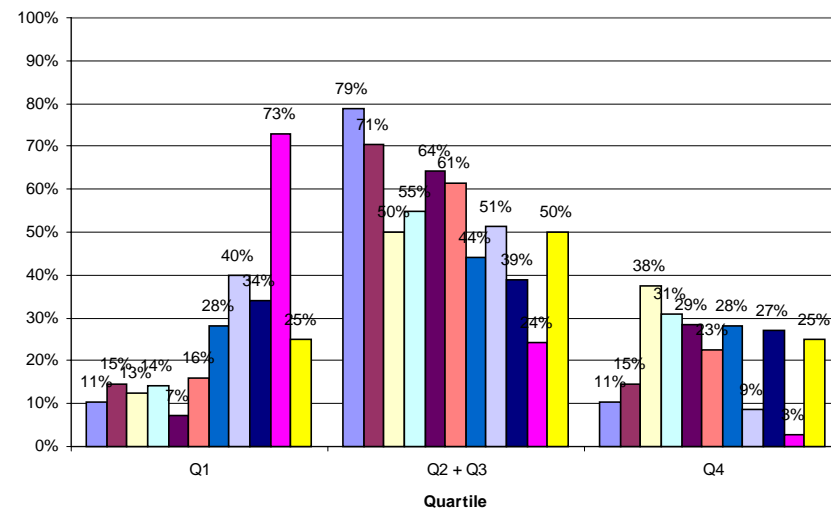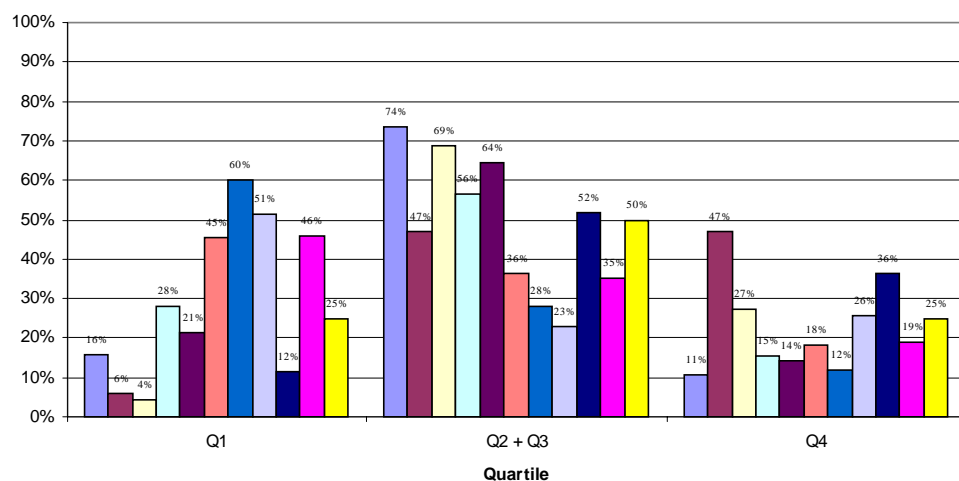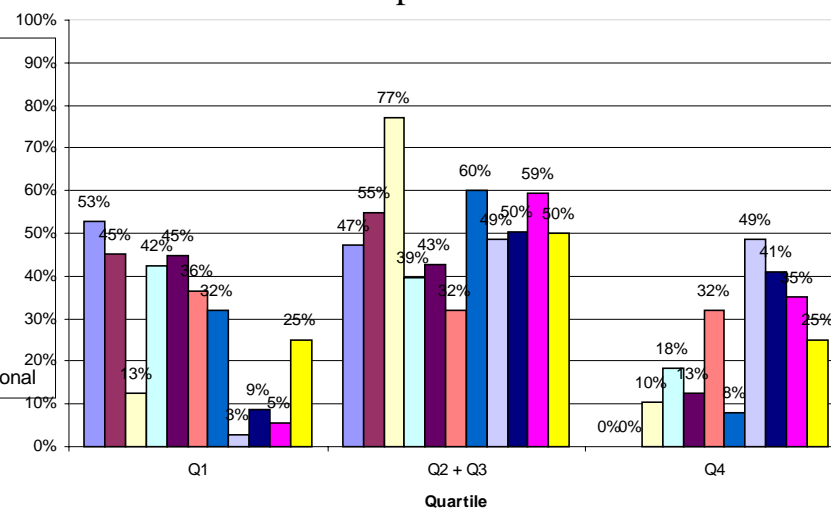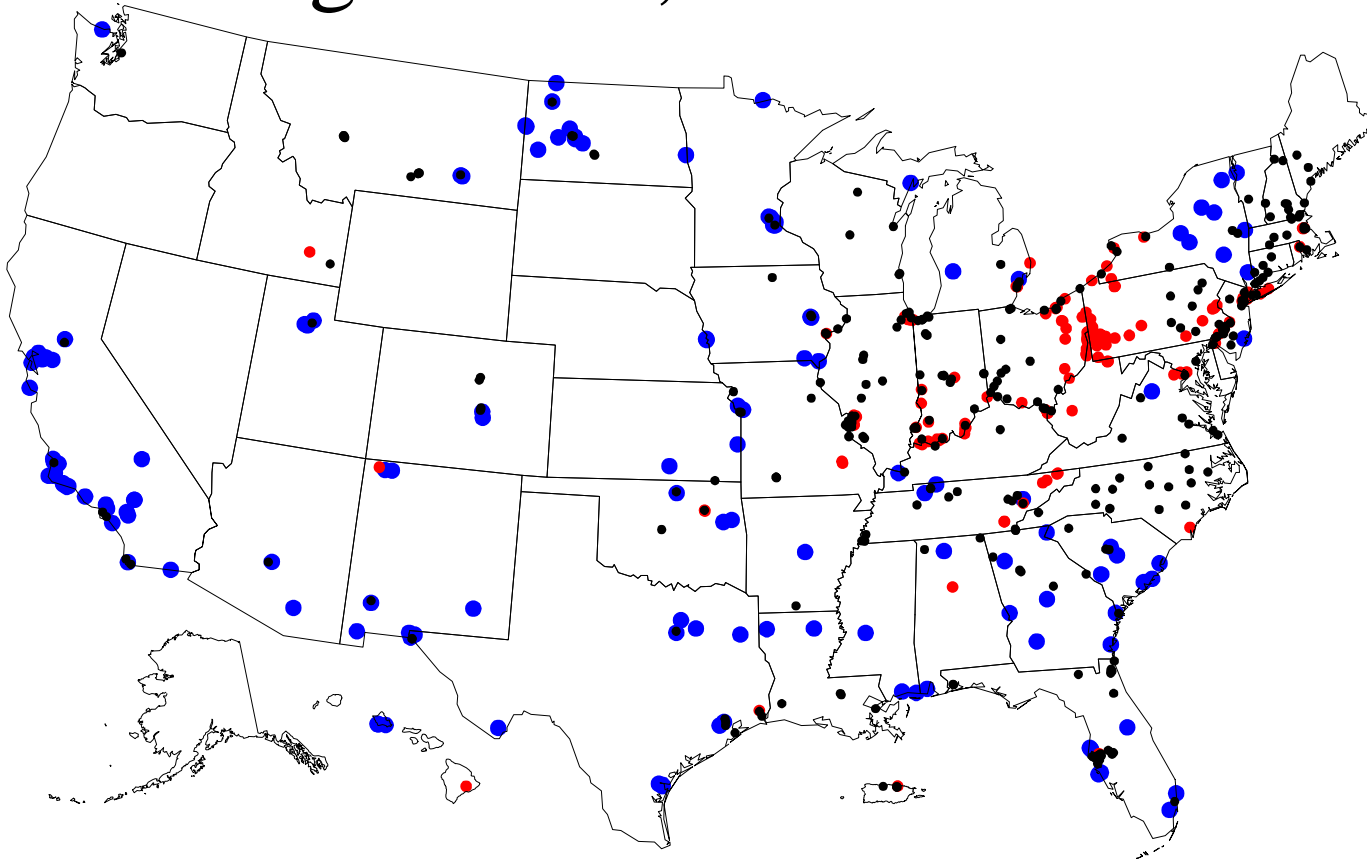
Regional Percent of Sites in National Quartiles

CO Aggregate Data
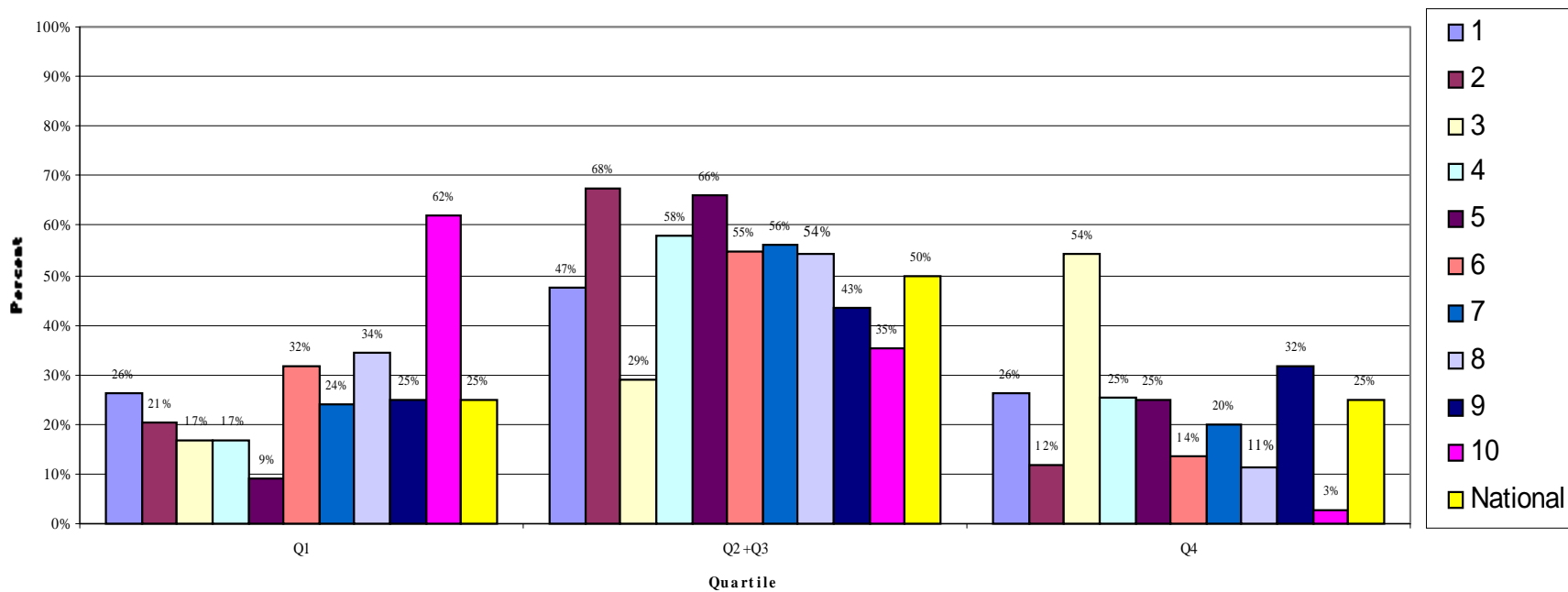
NO2 Annual Mean:
# Red=Large Value, Blue=Small Value
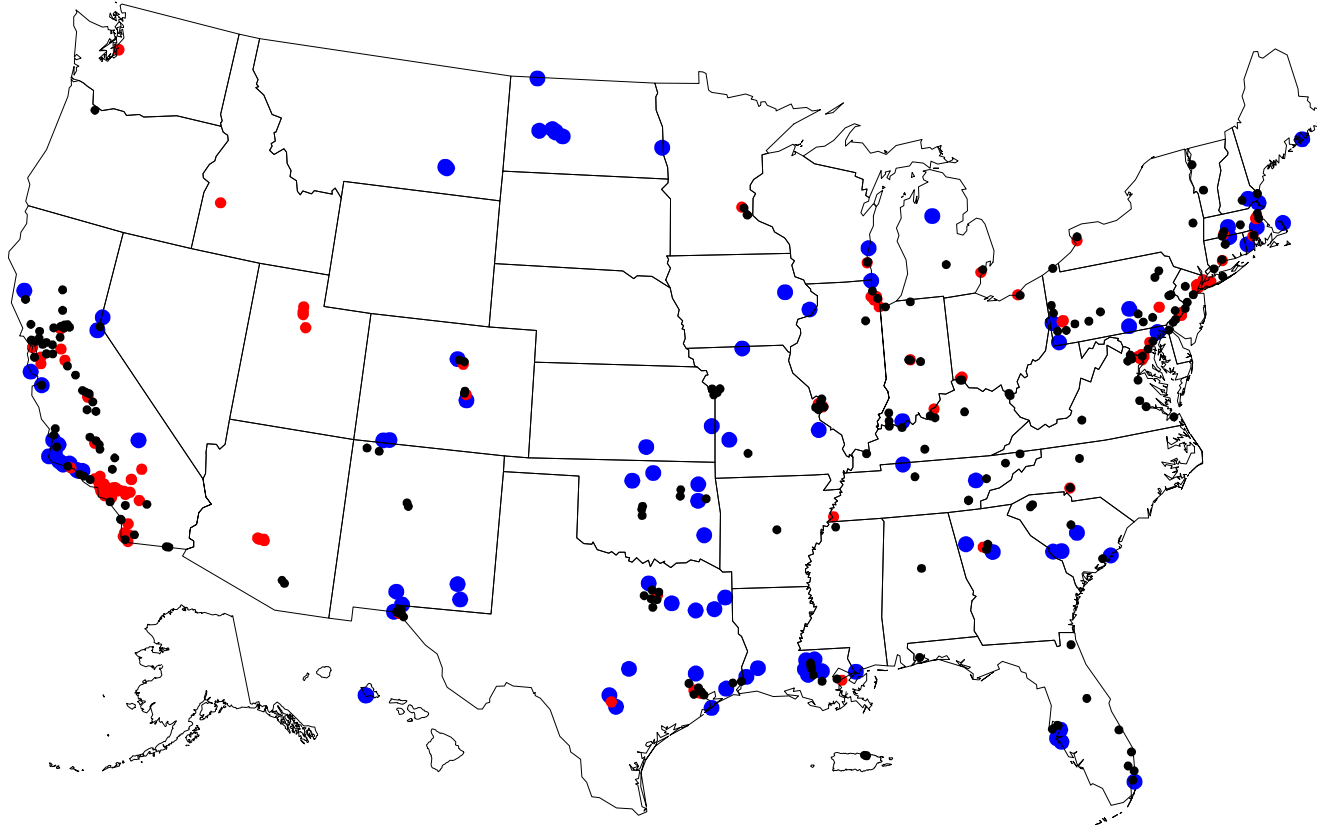
NO2 Annual Mean: Red=Large Value, Blue=Small Value

Predicting NO2 Annual Mean:
Red=High Uncertainty, Blue=Low Uncertainty
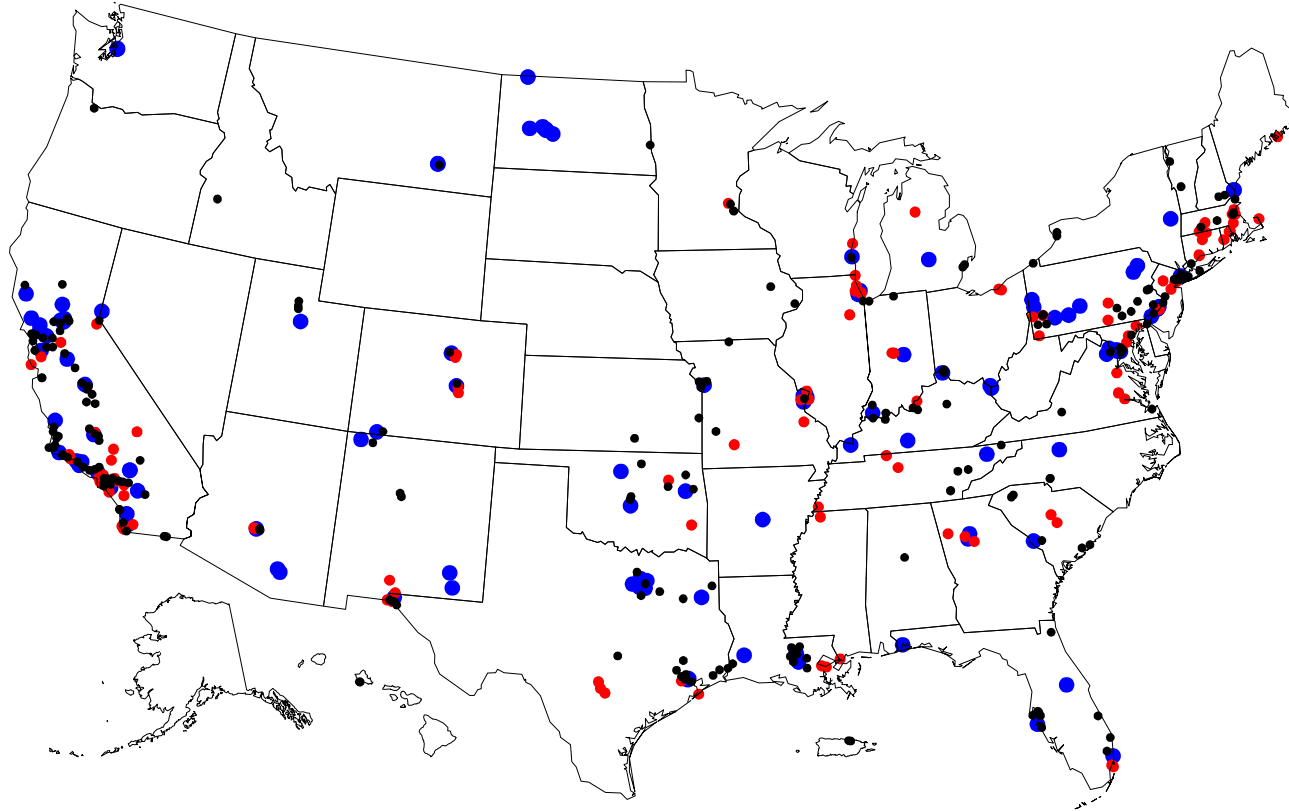
Predicting NO2 Annual Mean: Red=High Uncertainty, Blue=Low Uncertainty

Deviation from NO2 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation
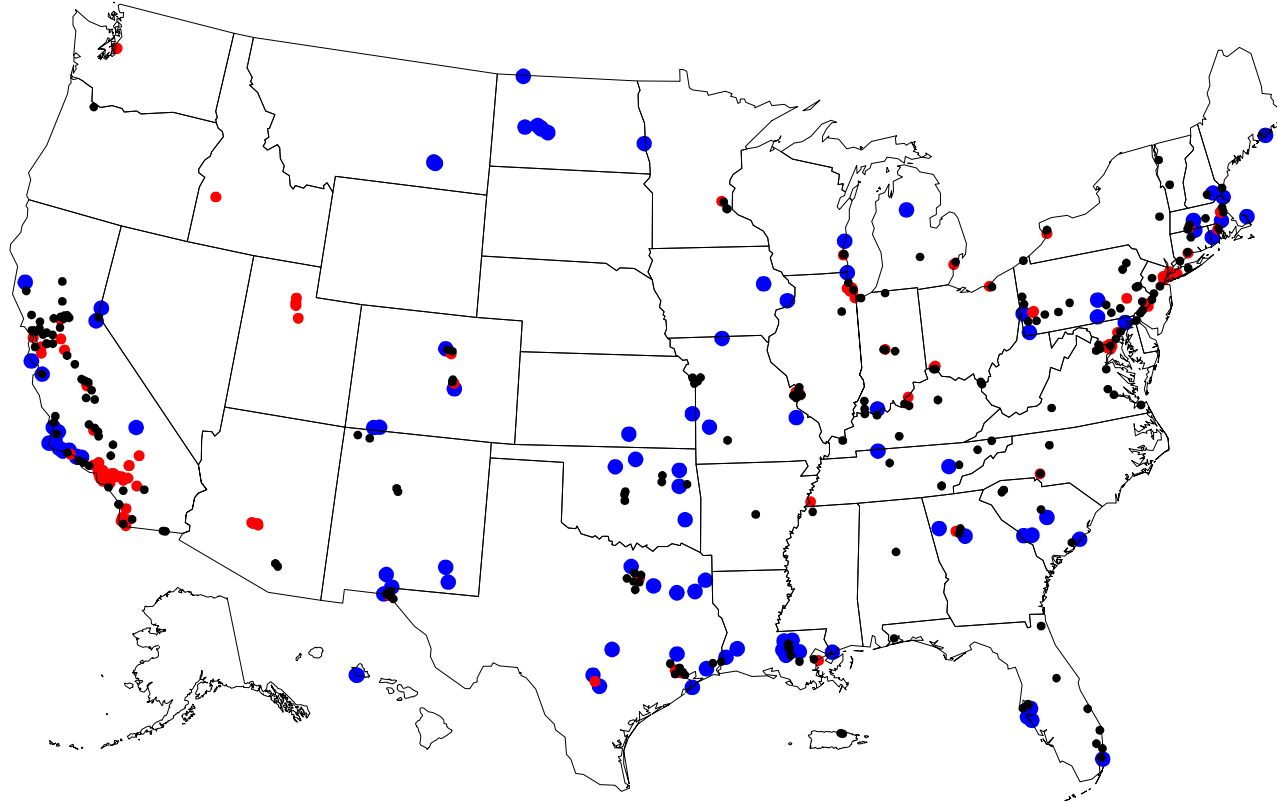
Deviation from NO2 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation

Area for NO2 Monitors:
Red=Large Area, Blue=Small Area
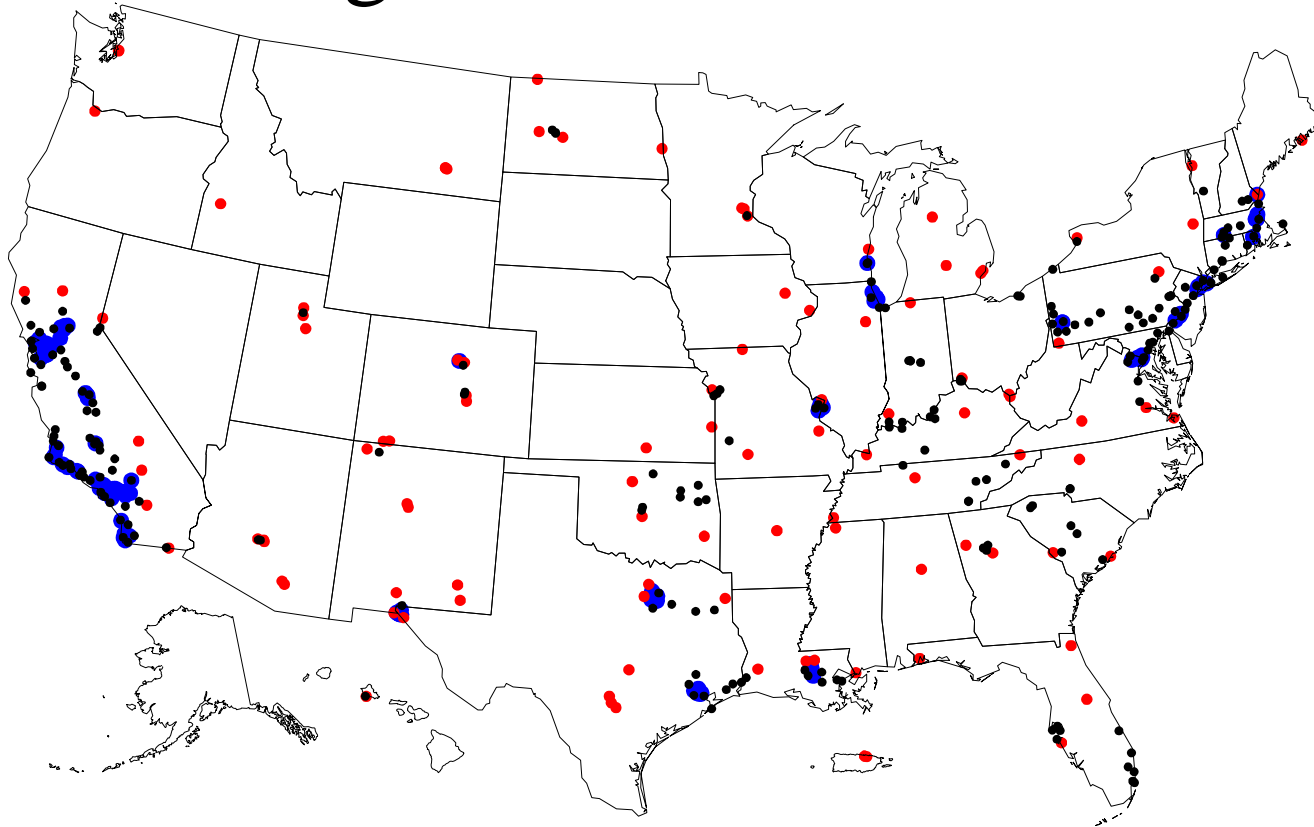
Area for NO2 Monitors: Red=Large Area, Blue=Small Area

Population for NO2 Monitors:
Red=Large Population, Blue=Small Population
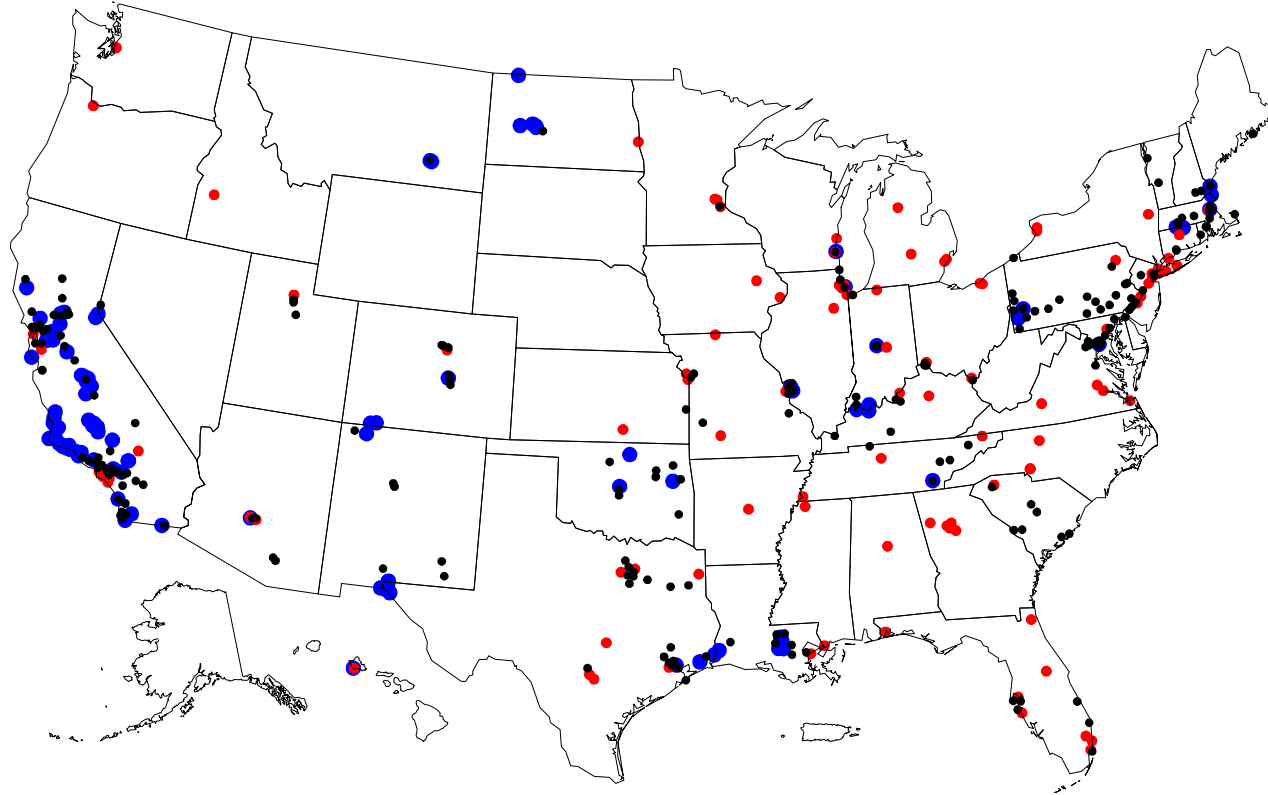
Population for NO2 Monitors: Red=Large Population, Blue=Small Population

NO2 Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight of Rankings

Station Population
20%

Concentration
20%

Station Area
20%

Near Standard
20%

Est. Uncertainty
20%

NO2 Aggregate Ranking Map: Red=High Value, Blue=Low Value

NO2 Quartiles

	NO2				
	no2mean	no2err	dif_NAAQS	area	population
Q1	0.02	0.00640006	0.033	21257.3968	836878
Q3	0.009	0.00171407	0.044	1516.8463	197759

Regional Percent of Sites in National Quartiles

NO2 Annual Mean Concentration
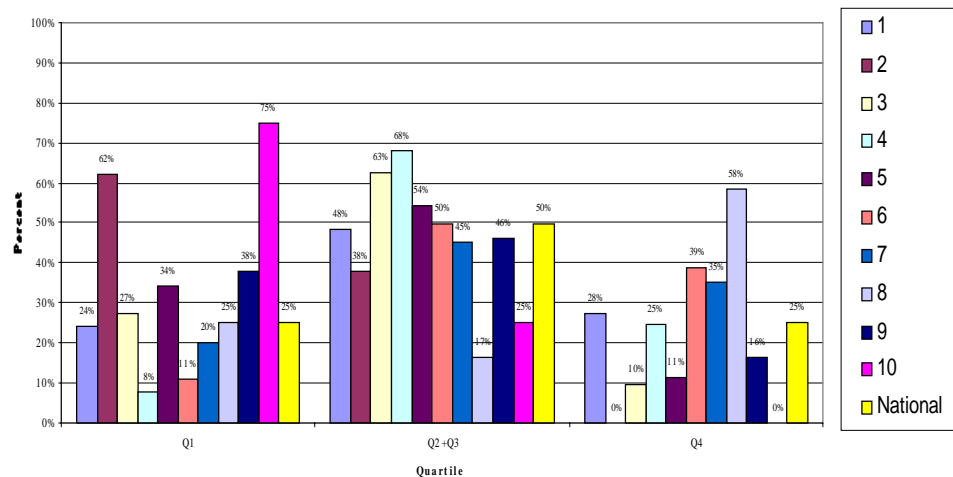
NO2 Uncertainty
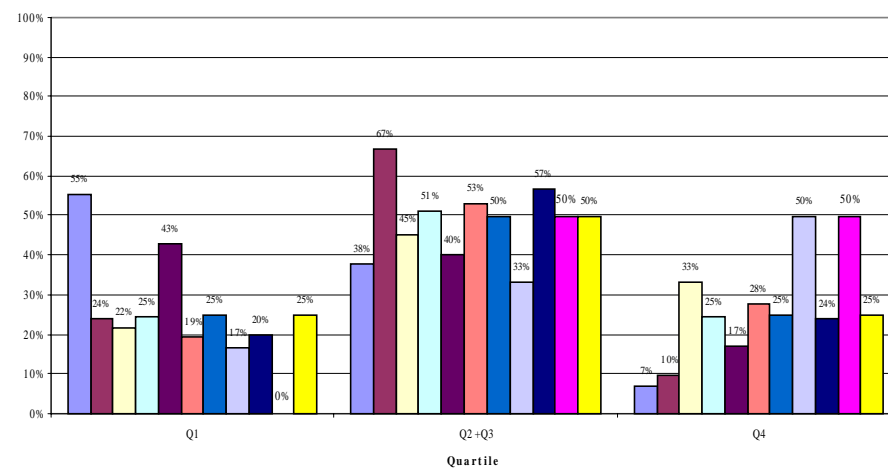
NO2 Deviation from NAAQS
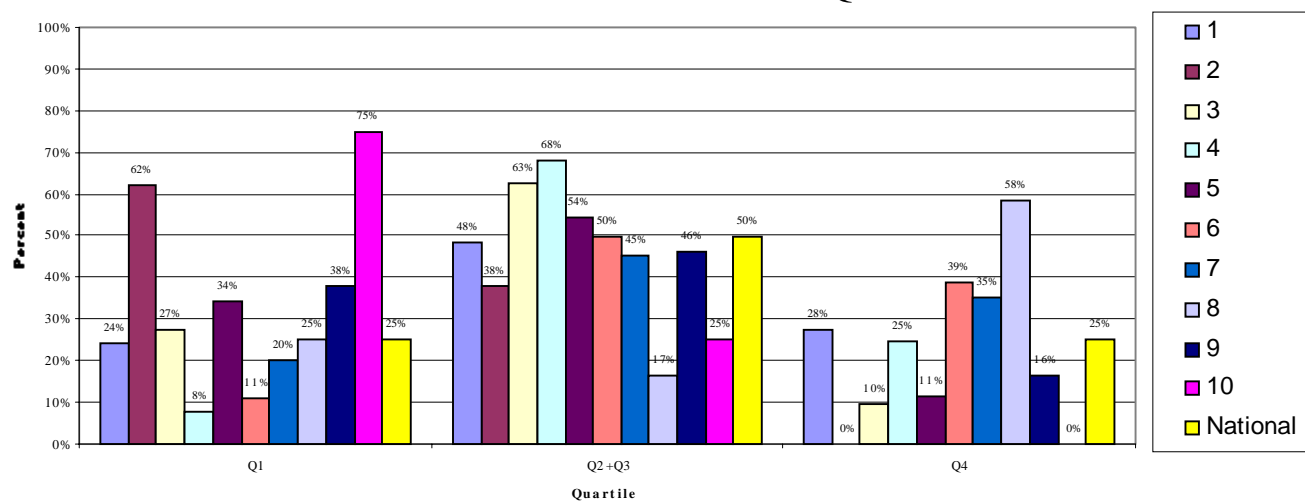
Regional Percent of Sites in National Quartiles

NO2 Area
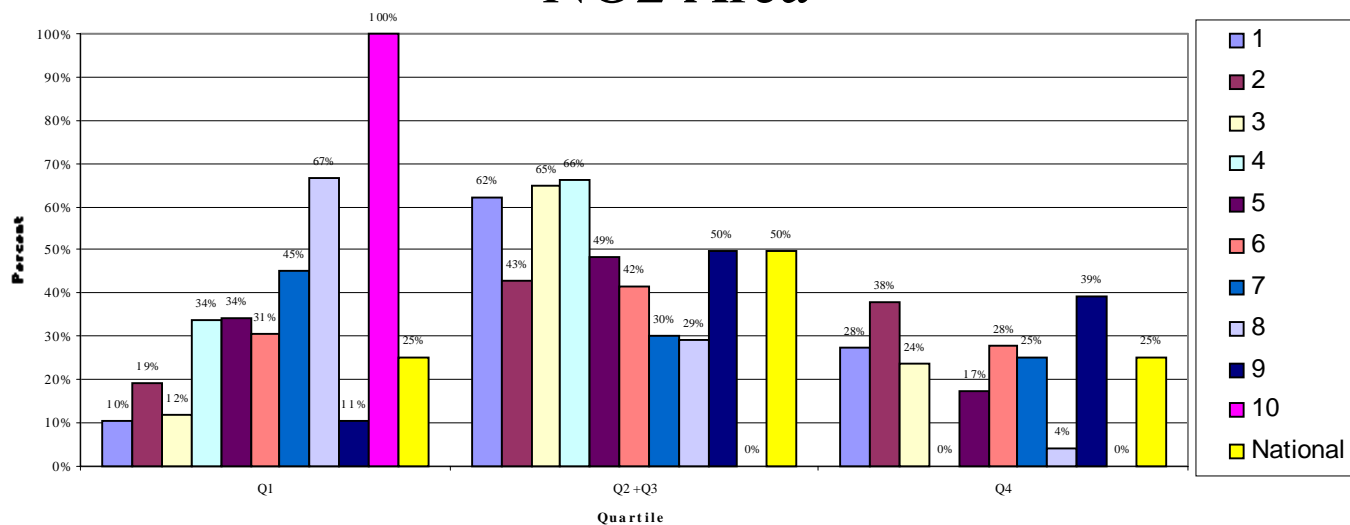
NO2 Population

Regional Percent of Sites in National Quartiles

NO2 Aggregate Data
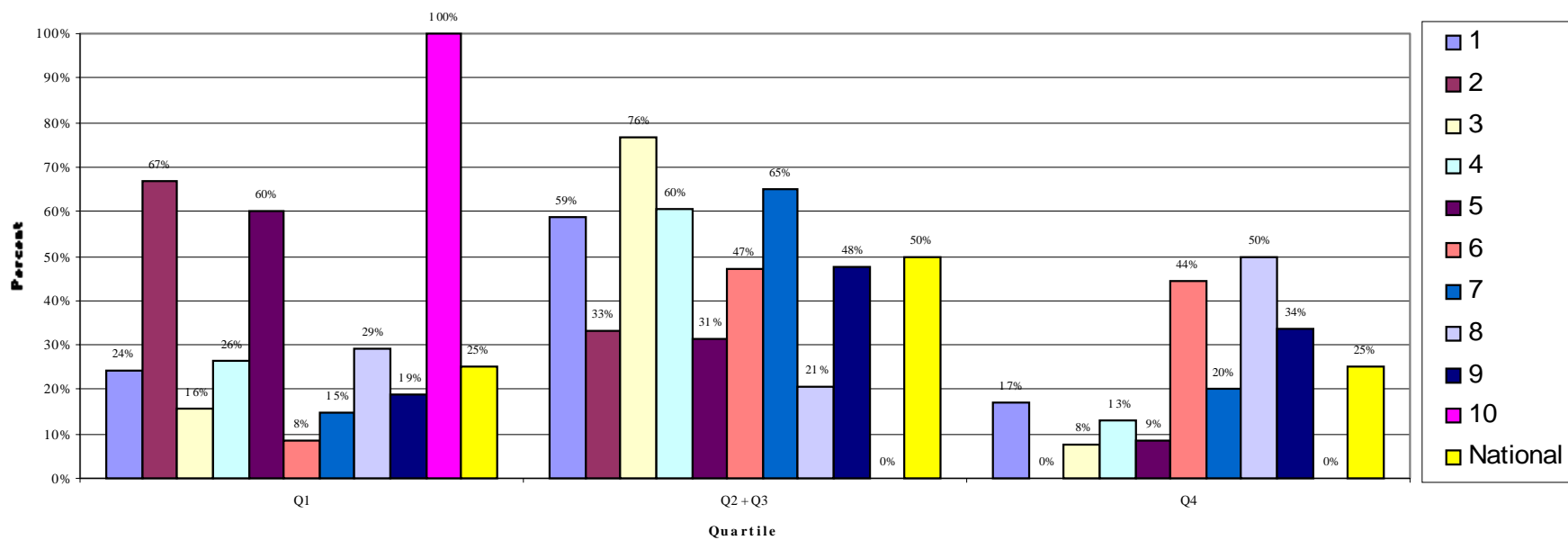
SO2 Annual Mean:
Red=Large Value, Blue=Small Value

SO2 Annual Mean: Red=Large Value, Blue=Small Value

SO2 2nd Max:
Red=Large Value, Blue=Small Value
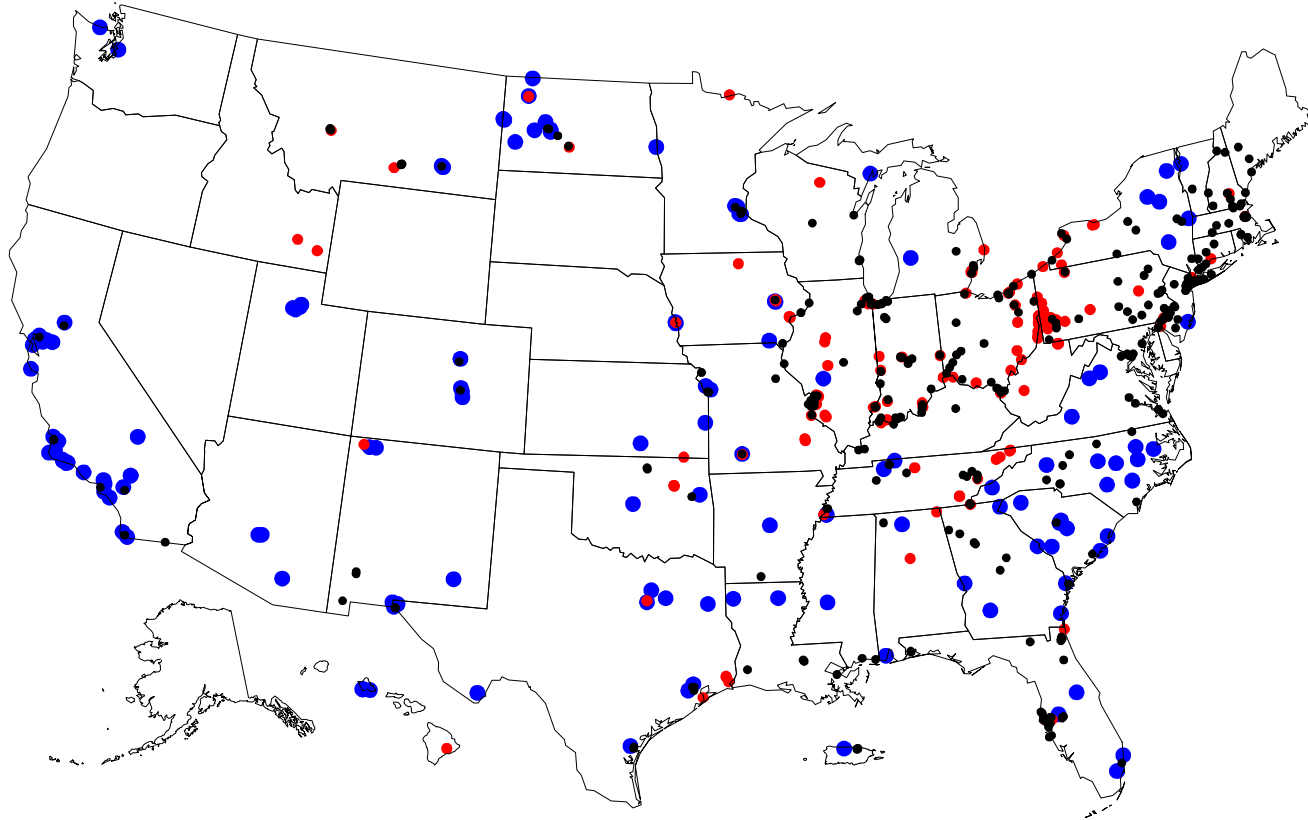
SO2 2nd Max: Red=Large Value, Blue=Small Value

Predicting SO2 Annual Mean:
Red=High Uncertainty, Blue=Low Uncertainty
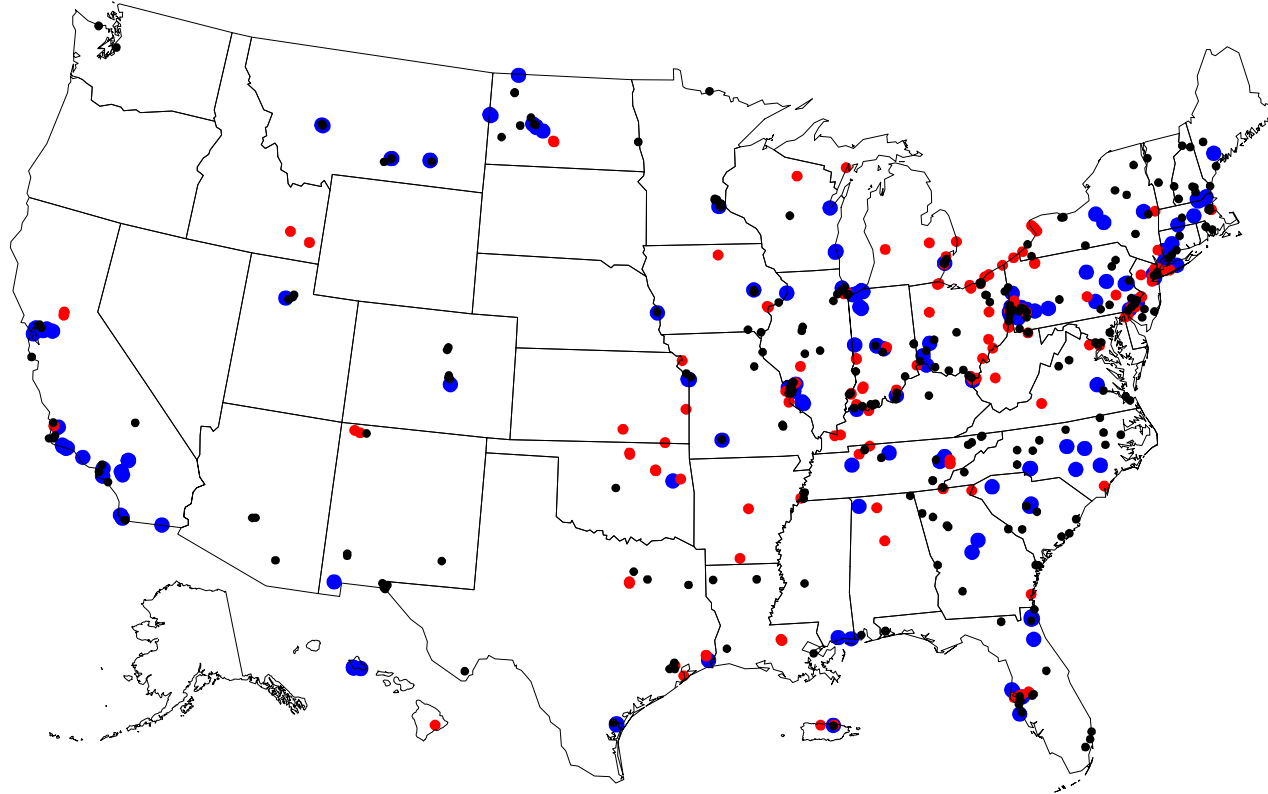
Predicting SO2 Annual Mean: Red=High Uncertainty, Blue=Low Uncertainty

Predicting SO2 2nd Max:
Red=High Uncertainty, Blue=Low Uncertainty
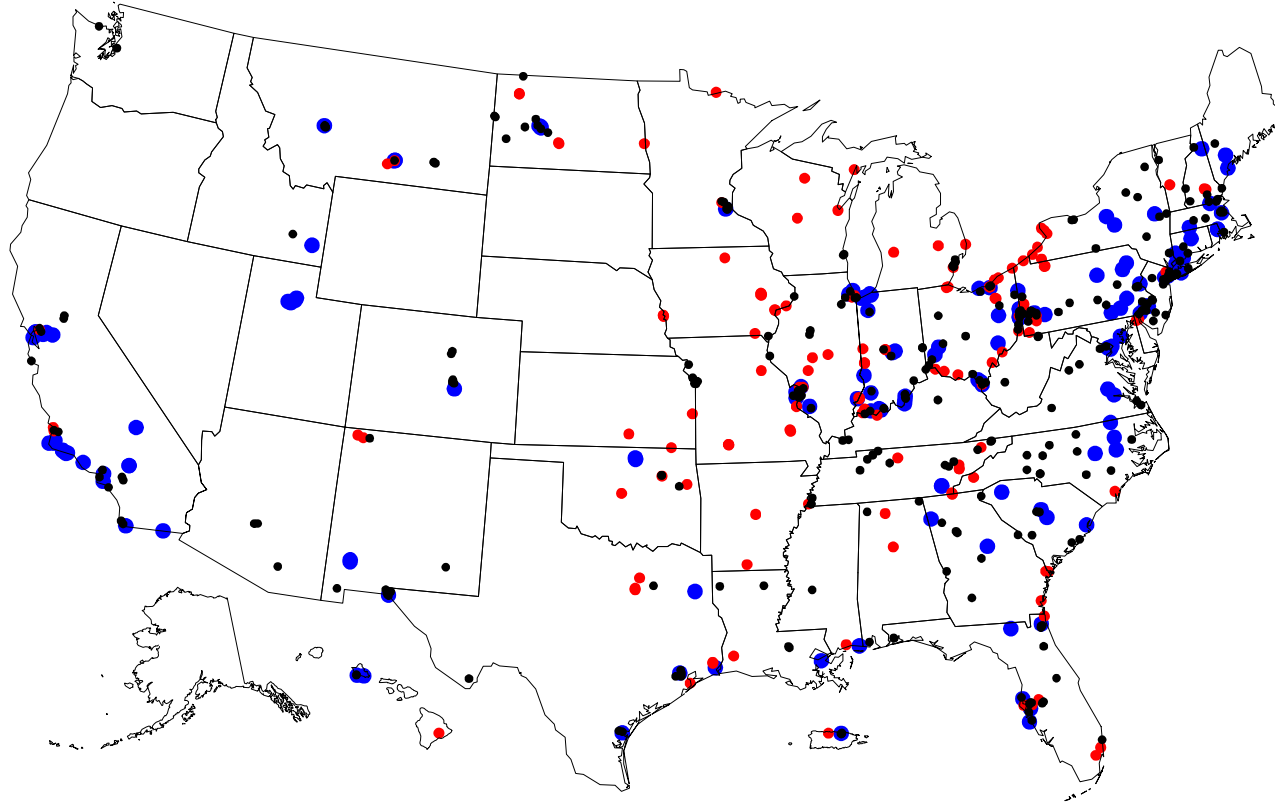
Predicting SO2 2nd Max: Red=High Uncertainty, Blue=Low Uncertainty

Deviation from SO2 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation
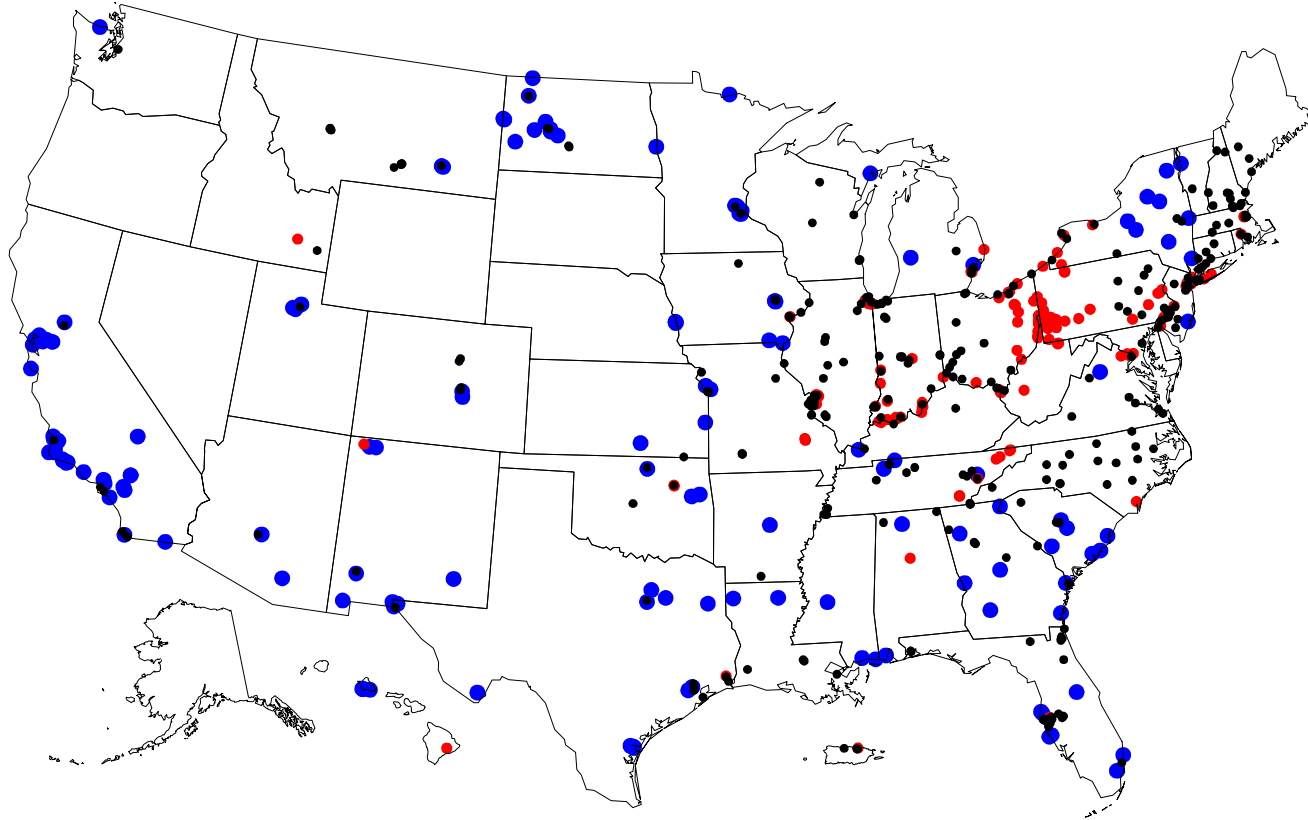
Deviation from SO2 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation

Deviation from SO2 24-Hour NAAQS:
Red=Small Deviation, Blue=Large Deviation
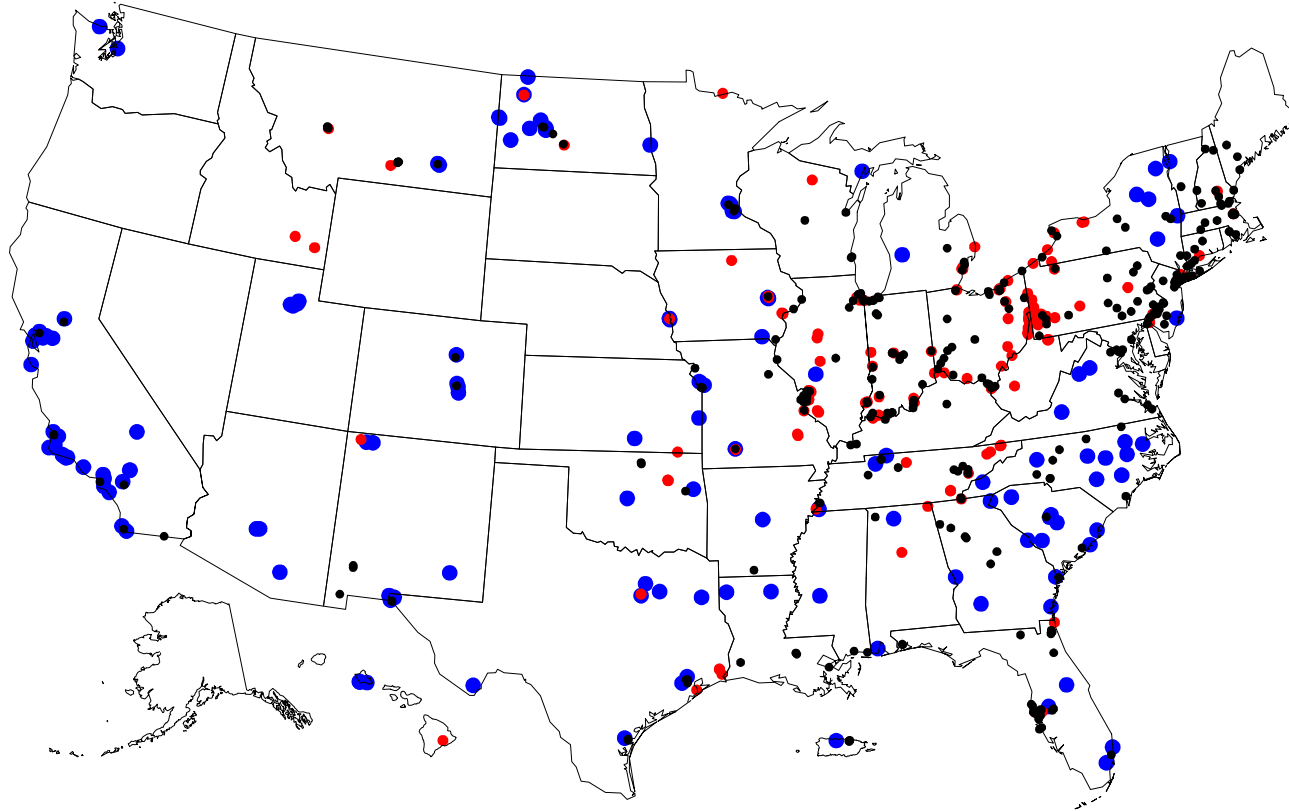
Deviation from SO2 24-Hour NAAQS: Red=Small Deviation, Blue=Large Deviation

Area for SO2 Monitors: Red=Large Area, Blue=Small Area
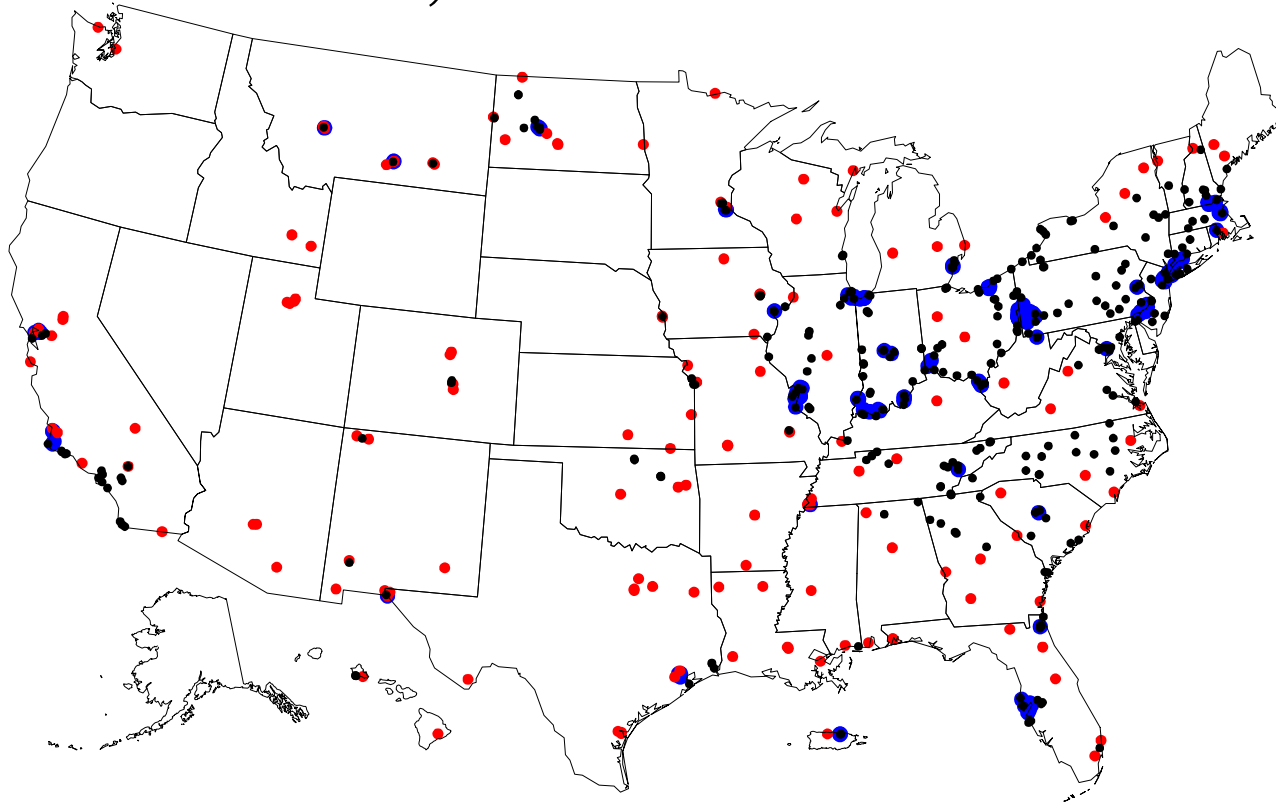
Area for SO2 Monitors: Red=Large Area, Blue=Small Area

Population for SO2 Monitors:
Red=Large Population, Blue=Small Population

SO2 Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight of Rankings

Station Population
12.5%

Mean Concentration
12.5%

Station Area
12.5%

2nd Max Concentration
12.5%

2nd Max Est. Uncertainty
12.5%

Mean Value Near Standard
12.5%

Mean Est. Uncertainty
12.5%

2nd Max Near Standard
12.5%

SO2 Aggregate Ranking Map: Red=High Value, Blue=Low Value
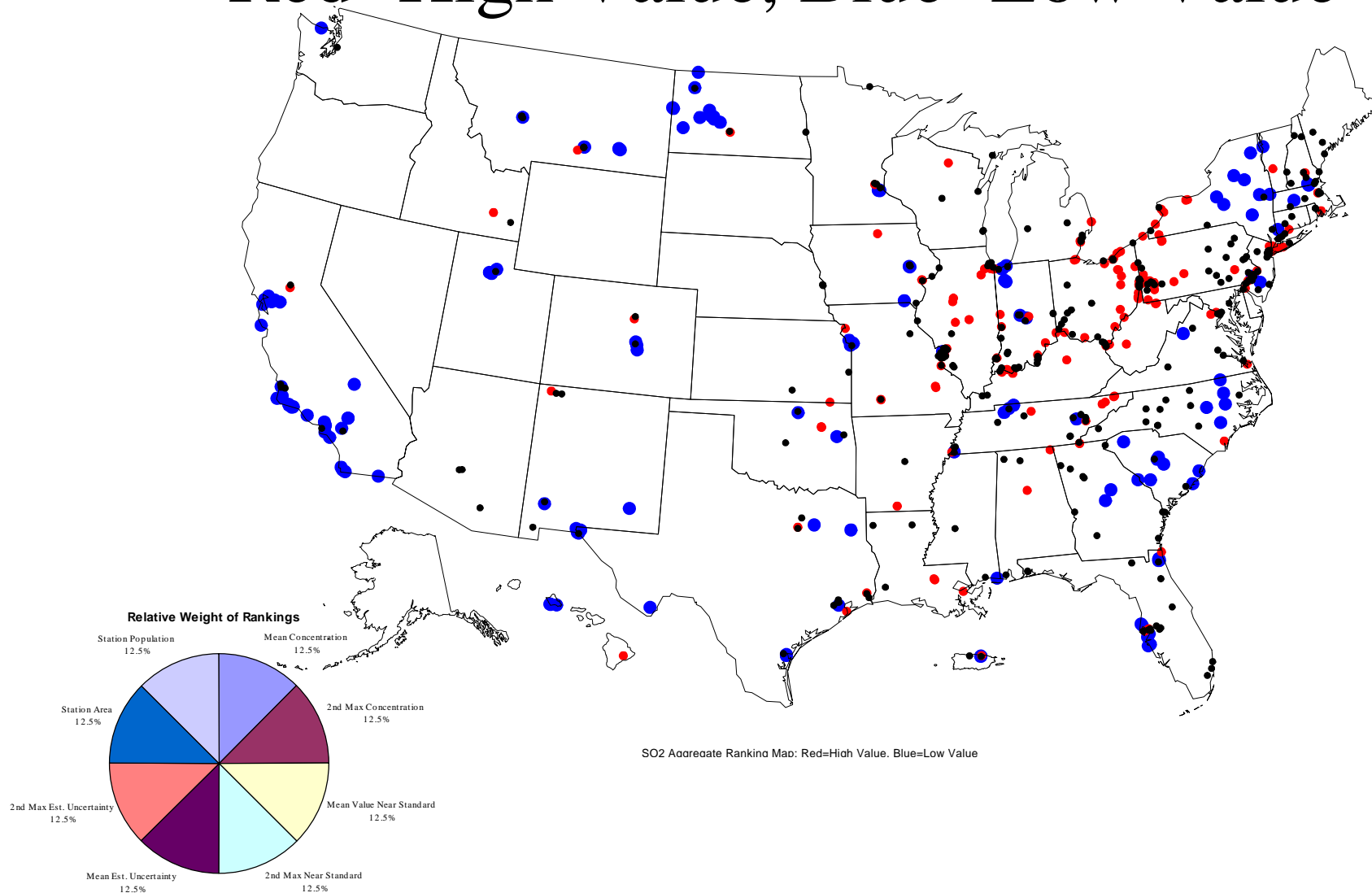
SO2 Quartiles

	SO2							
	so2mean	so22x	so2meanerr	so22xerr	dif_NAAQS_mean	dif_NAAQS_2x	area	population
Q1	0.0067	0.0295	0.001805167	0.01152468	0.0233	0.1105	14639.7	595466
Q3	0.0028	0.012	0.000401737	0.00254945	0.0272	0.128	1087.59	107189

Regional Percent of Sites in National Quartiles

Regional Percent of Sites in National Quartiles

SO2 Annual Mean Deviation from NAAQS
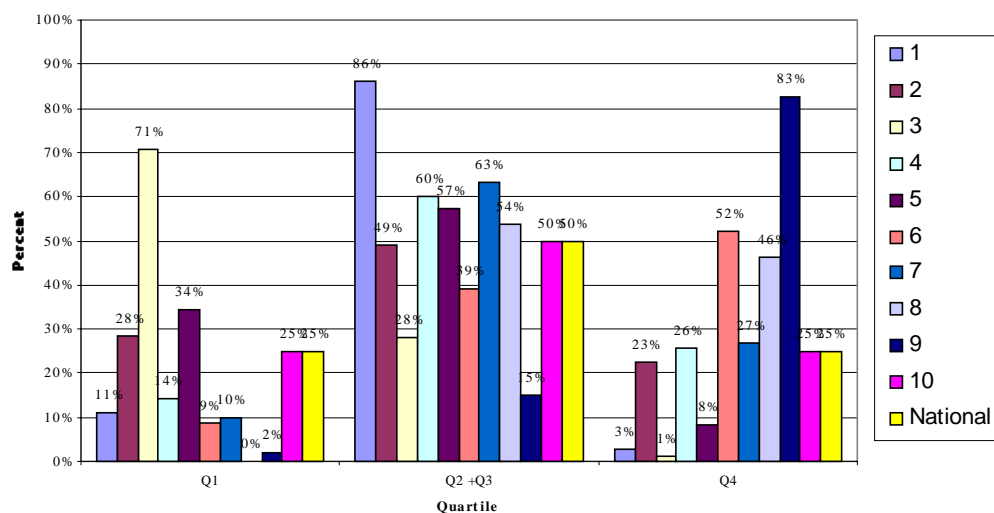
SO2 2nd Max Deviation from NAAQS
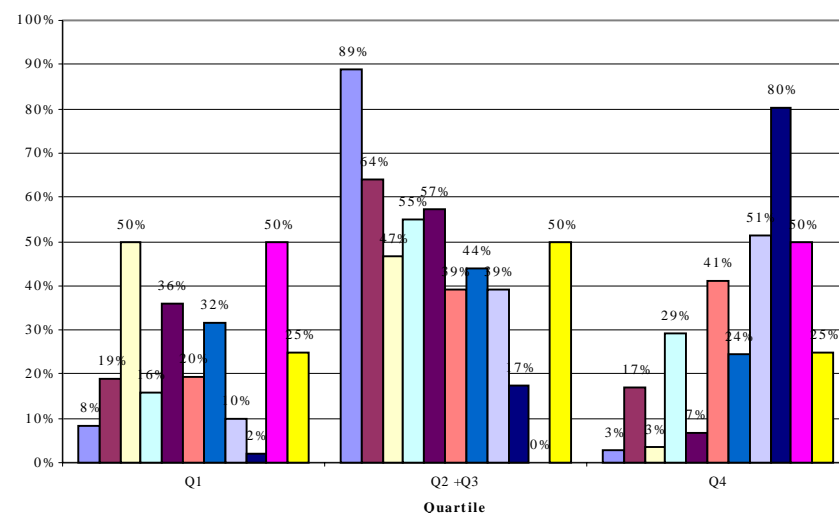
SO2 Area
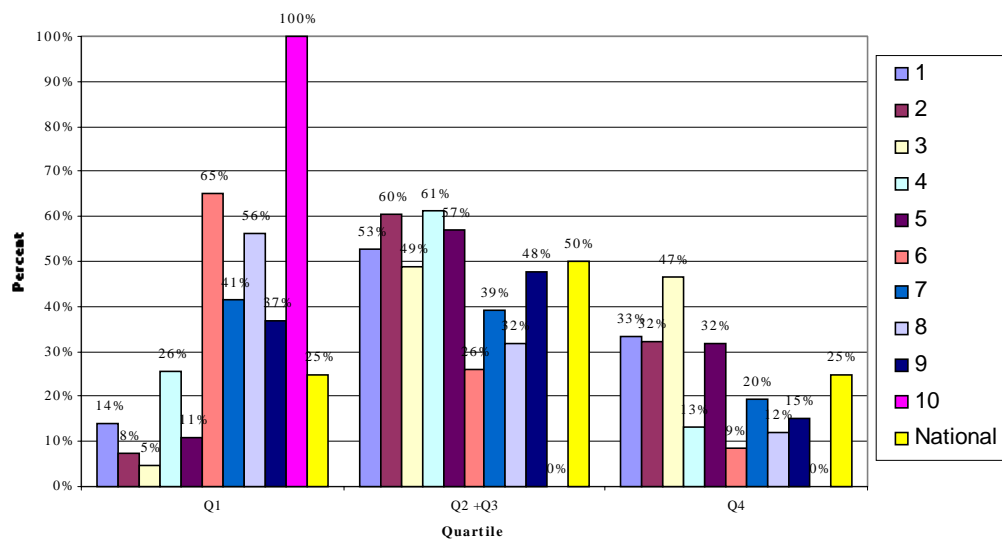
SO2 Population
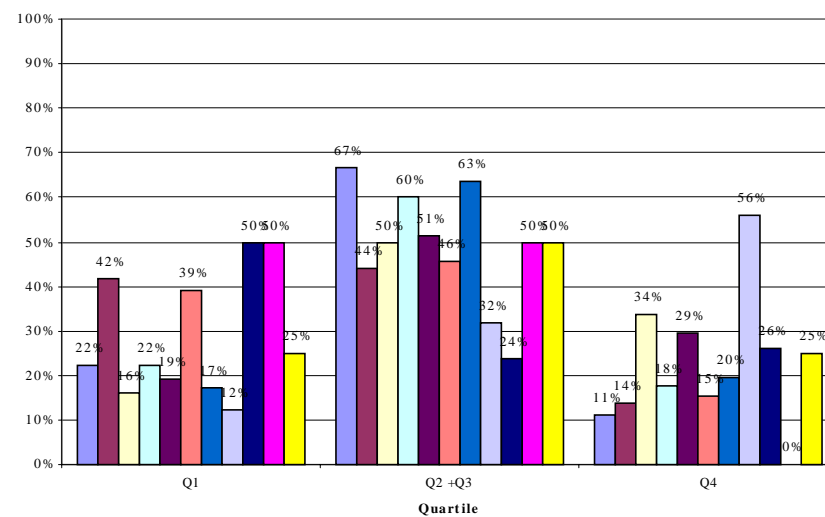
Regional Percent of Sites in National Quartiles

SO2 Aggregate Data
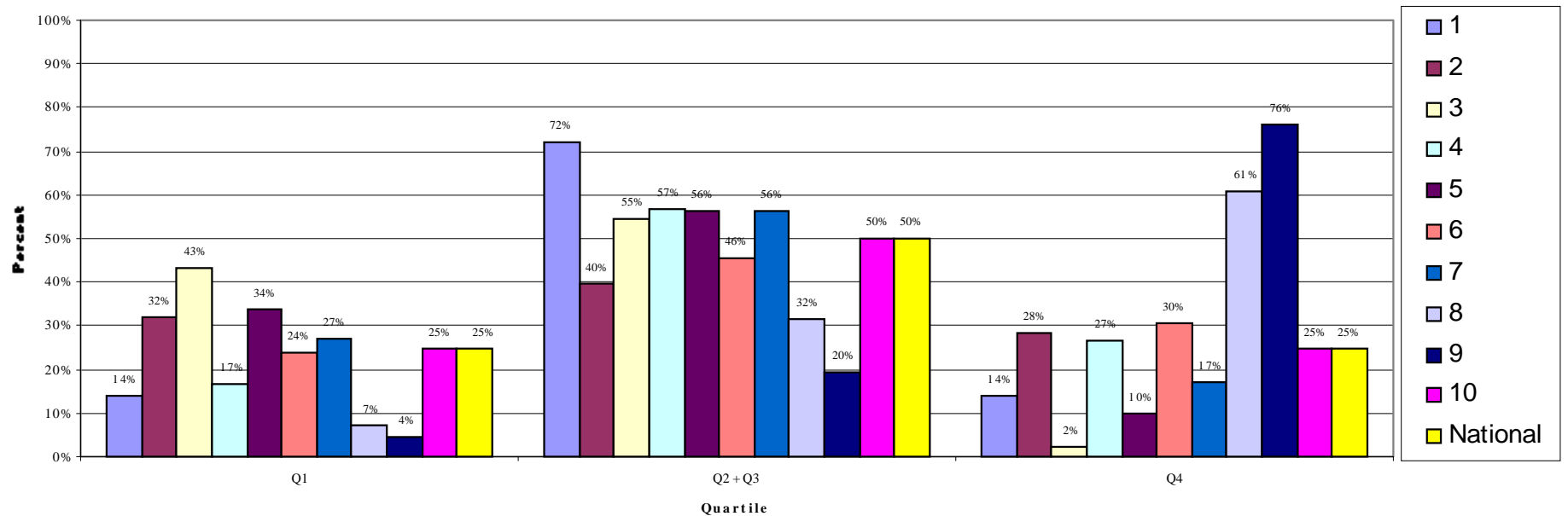
Pb Max Quarterly Average:
Red=Large Value, Blue=Small Value

Predicting Pb Max Quarterly Average:
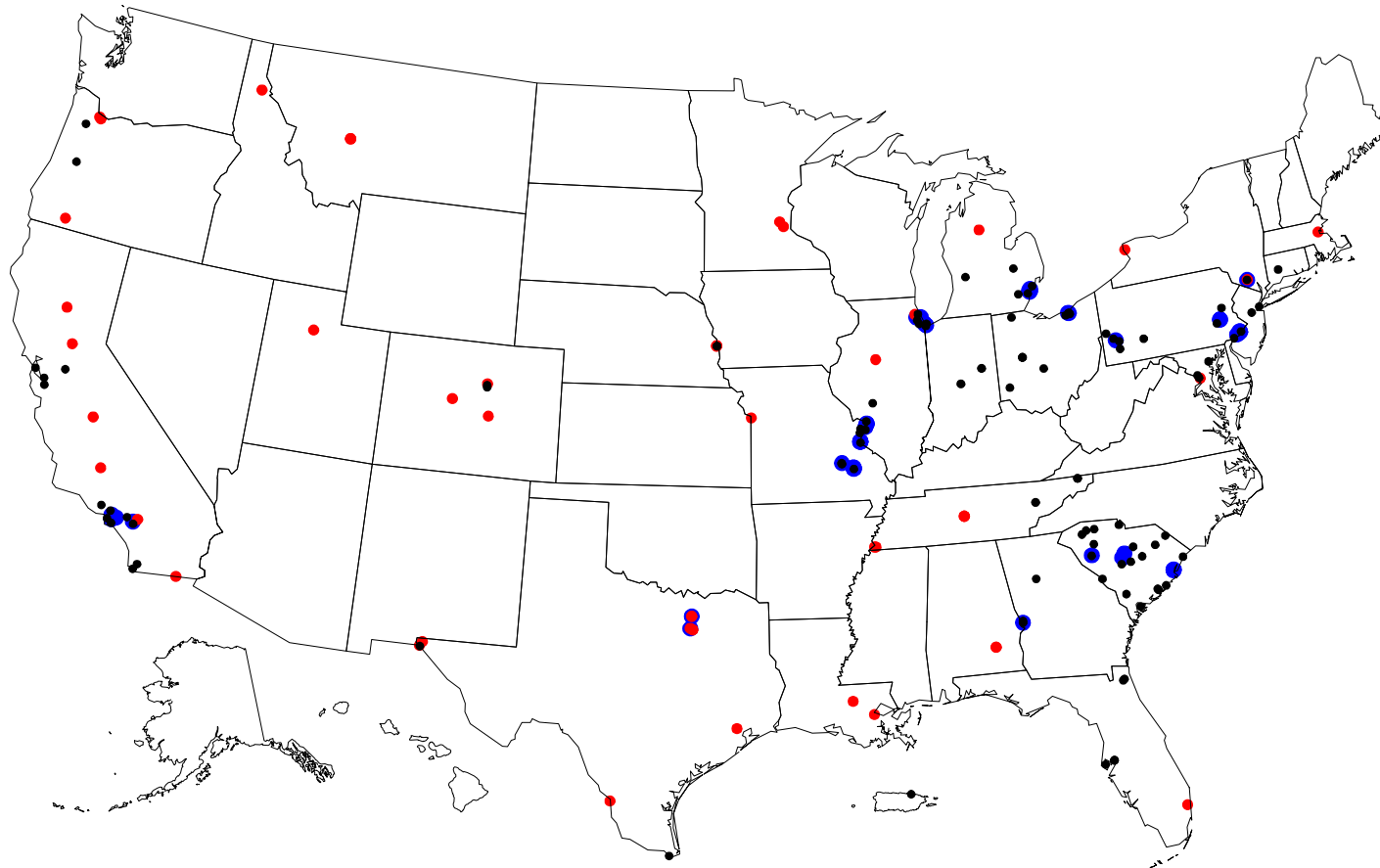Red=High Uncertainty, Blue=Low Uncertainty

Pb Max Quart. Avg. Deviation from NAAQS: Red=Small Deviation, Blue=Large Deviation

Area for Pb Monitors: Red=Large Area, Blue=Small Area

Area for Pb Monitors: Red=Large Area, Blue=Small Area

Population for Pb Monitors: Red=Large Population, Blue=Small Population

# Pb Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight of Rankings

Station Population
20%

Concentration
20%

Near Standard
20%

Est. Uncertainty
20%

Station Area
20%

Pb Aggregate Ranking Map: Red=High Value, Blue=Low Value
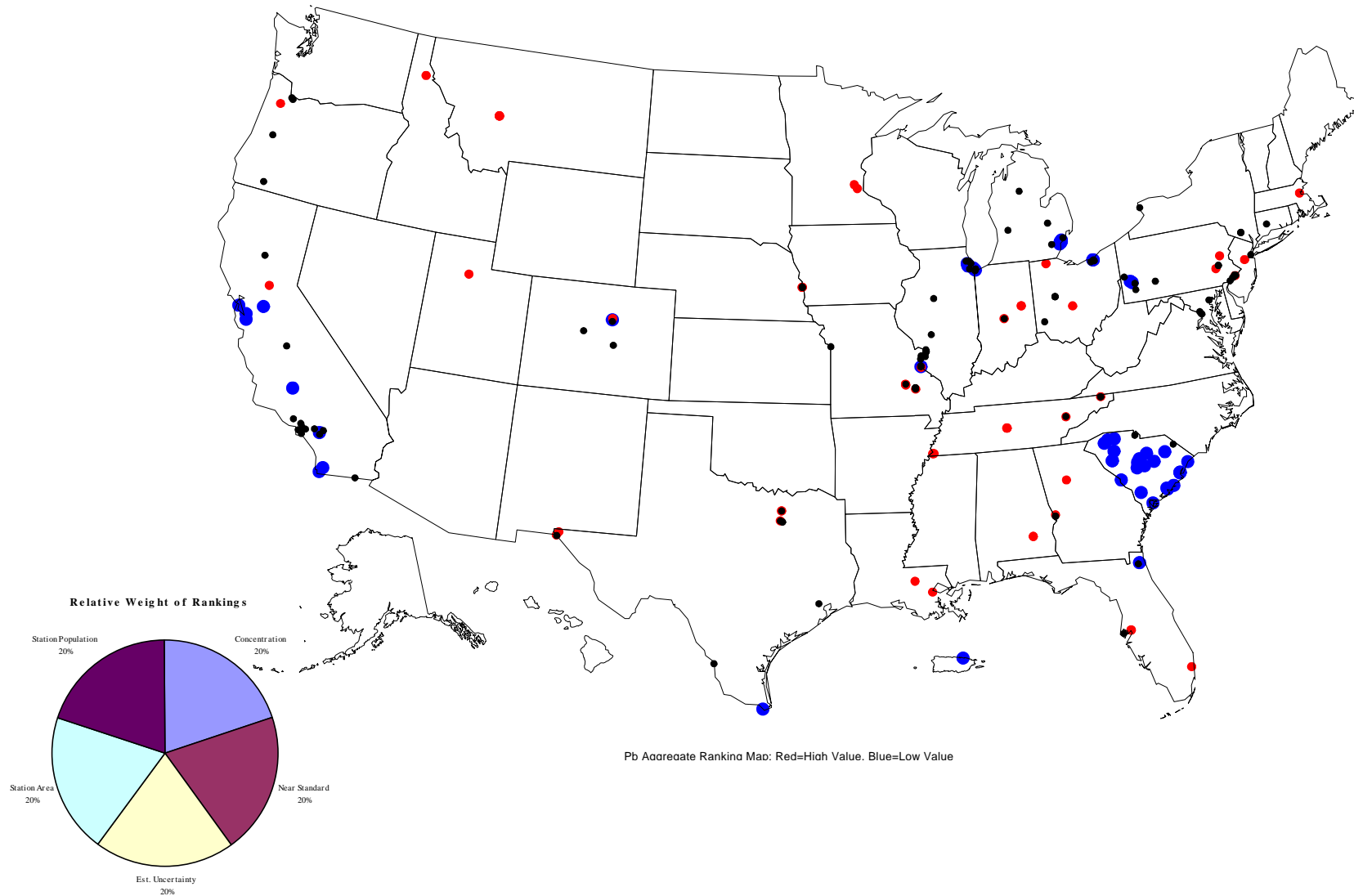
Pb Quartiles

	Pb				
	pbmax	pberr	dif_NAAQS_max	area	population
Q1	0.19	0.2004	1.32	58037.6	1955120
Q3	0.02	0.0106	1.48	2362.35	254385

Regional Percent of Sites in National Quartiles

Pb Max Quarterly Average Concentration
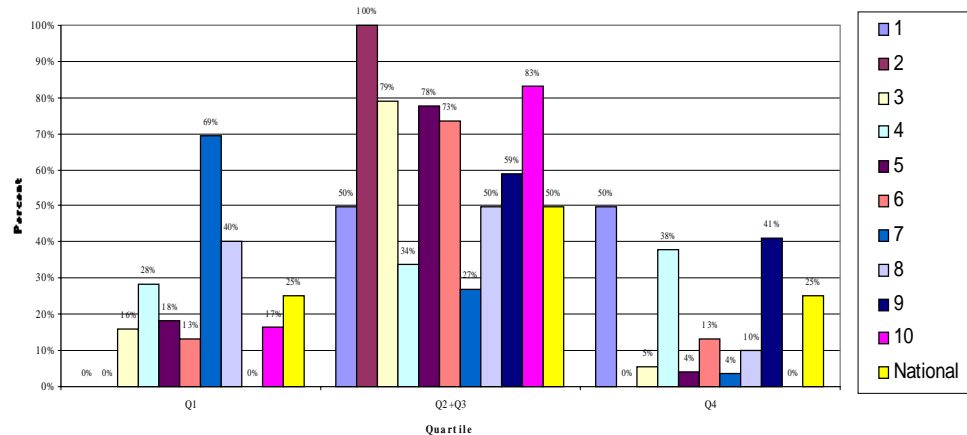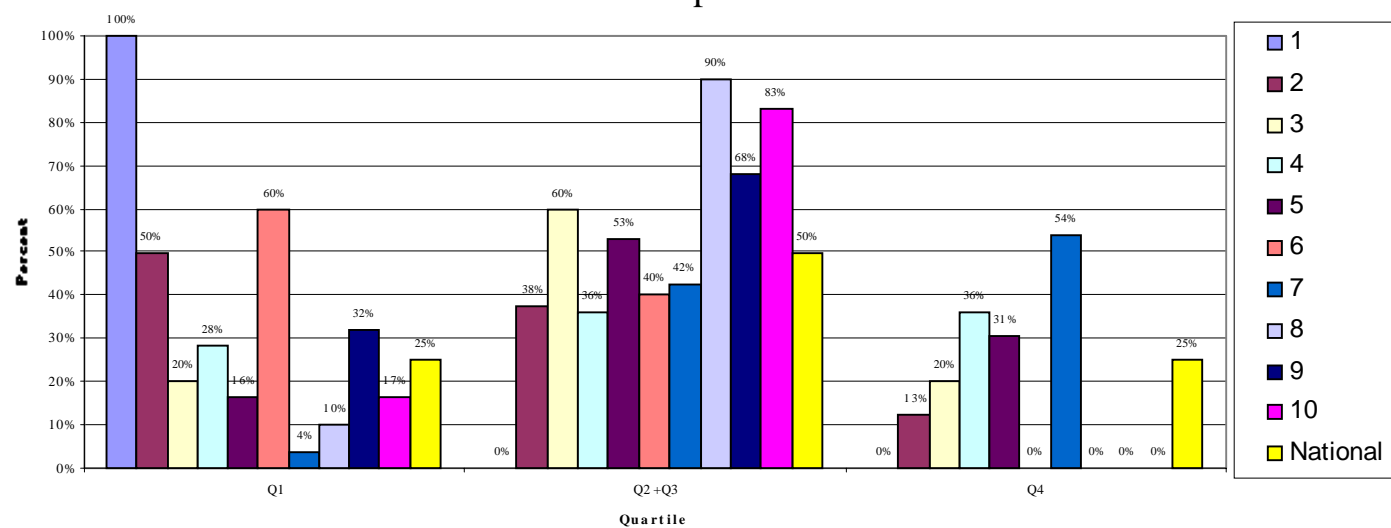
Pb Uncertainty
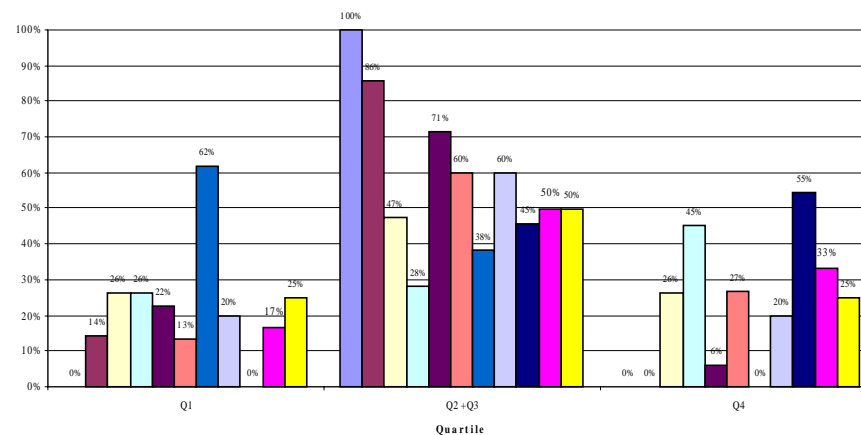
Pb Deviation from NAAQS
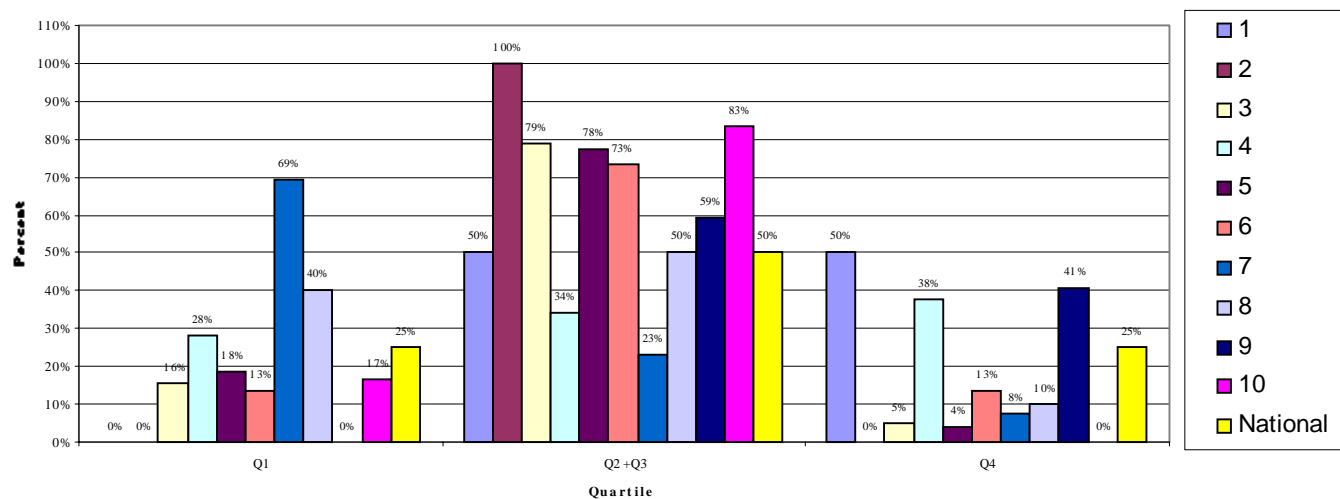
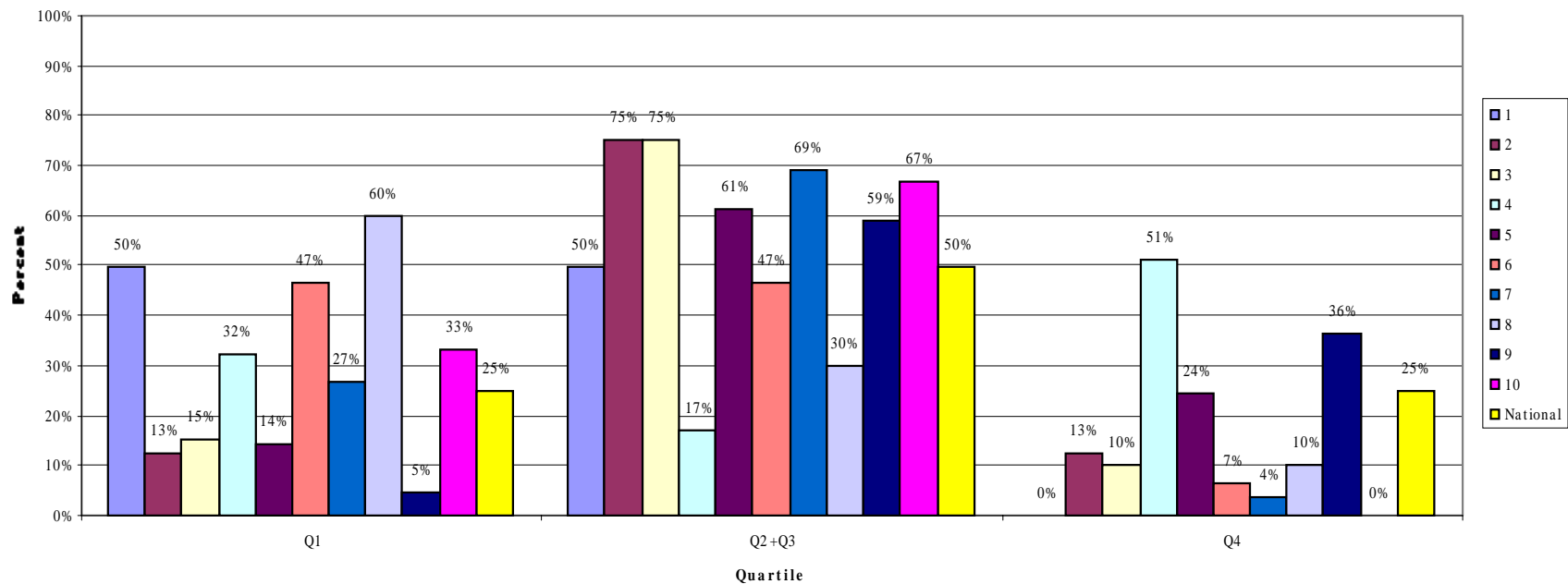# Regional Percent of Sites in National Quartiles
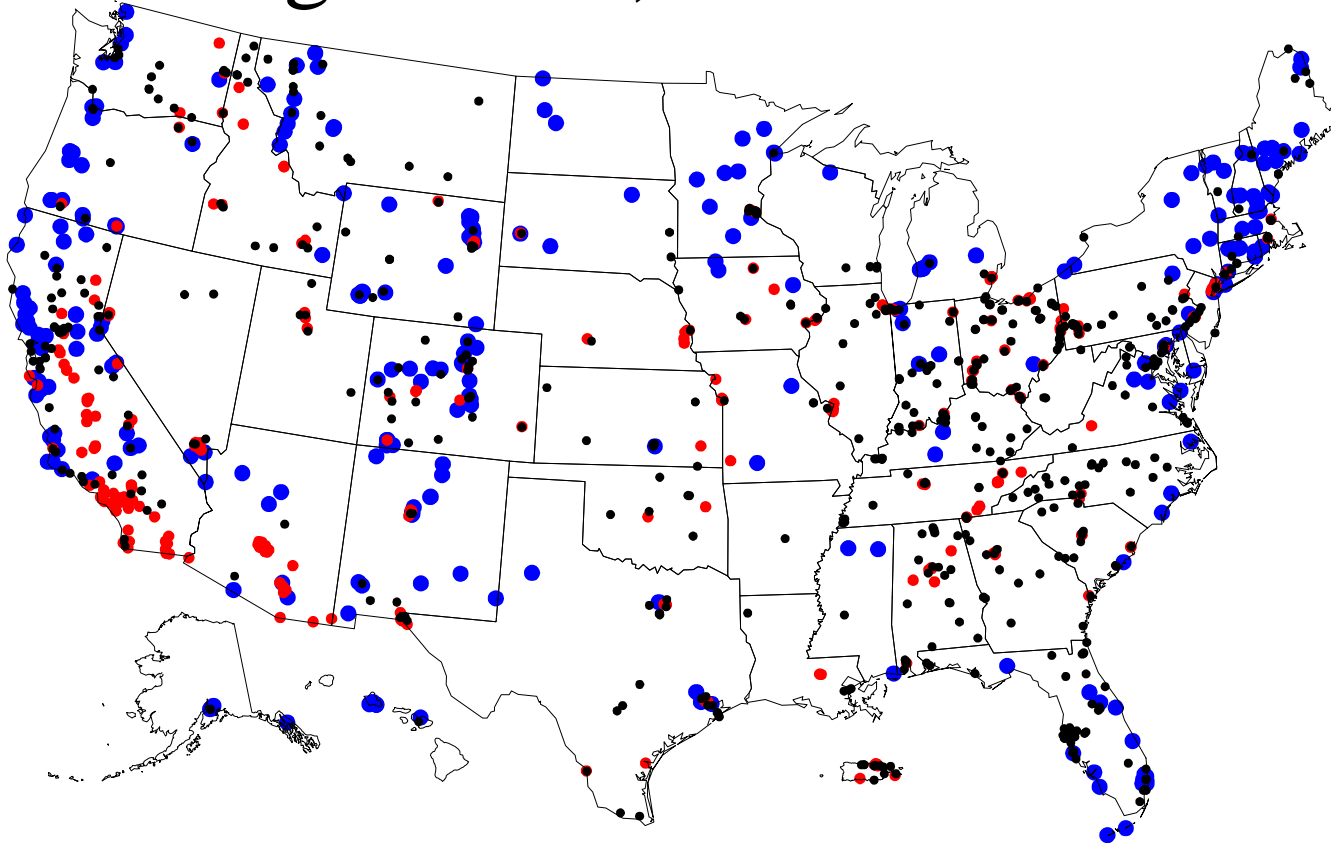

Pb Area
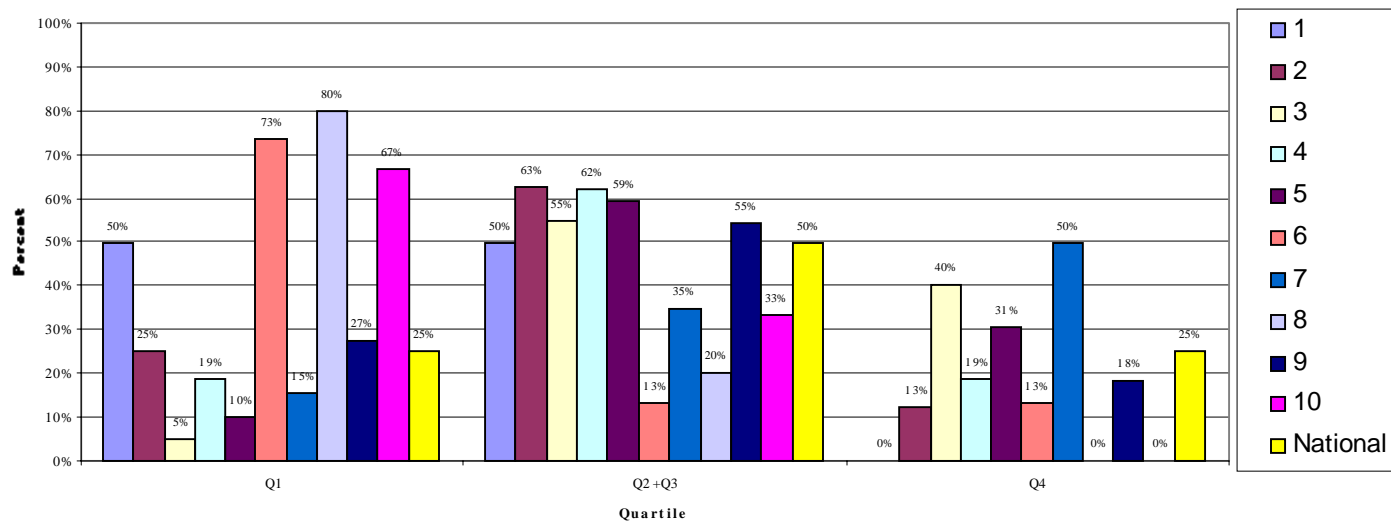
Pb Population

Regional Percent of Sites in National Quartiles
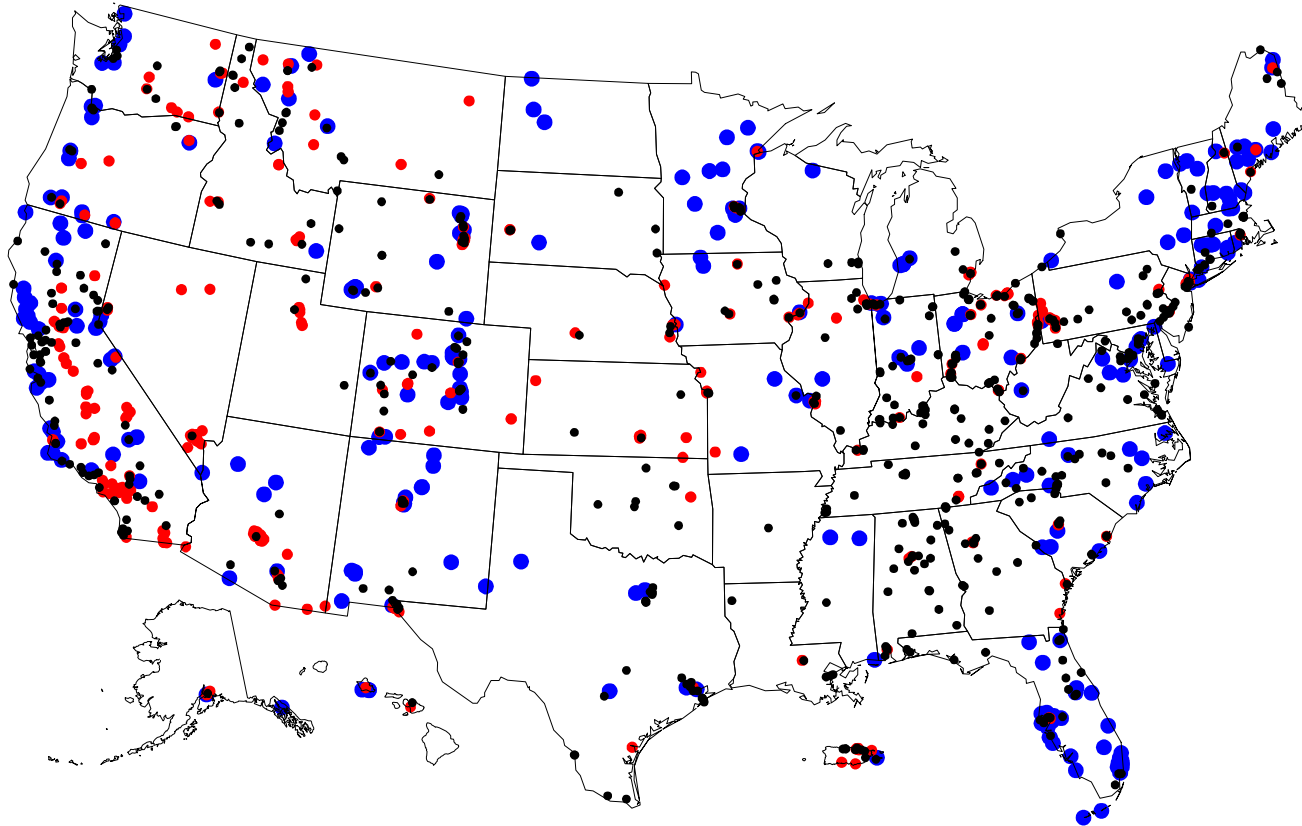
Pb Aggregate Data

PM10 Annual Mean:
Red=Large Value, Blue=Small Value

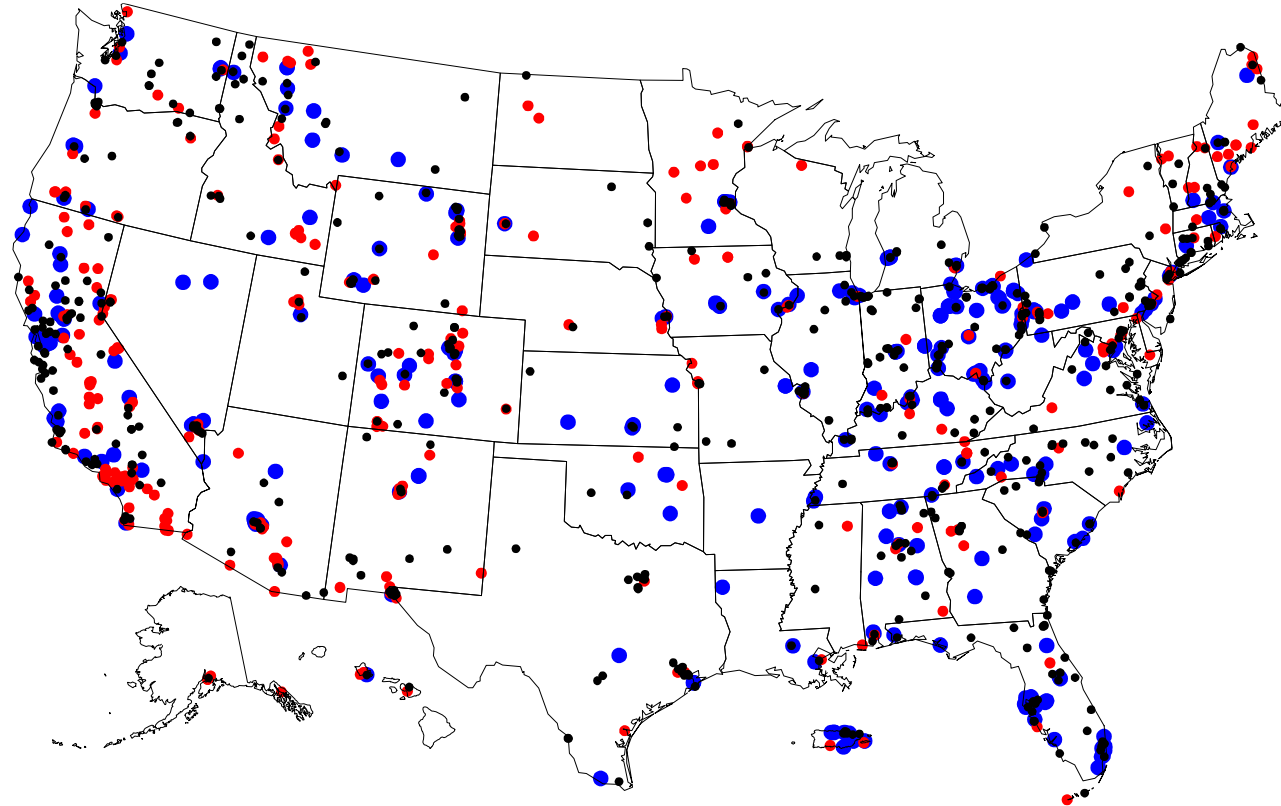PM10 Annual Mean: Red=Large Value, Blue=Small Value

PM10 2ⁿᵈ Max:
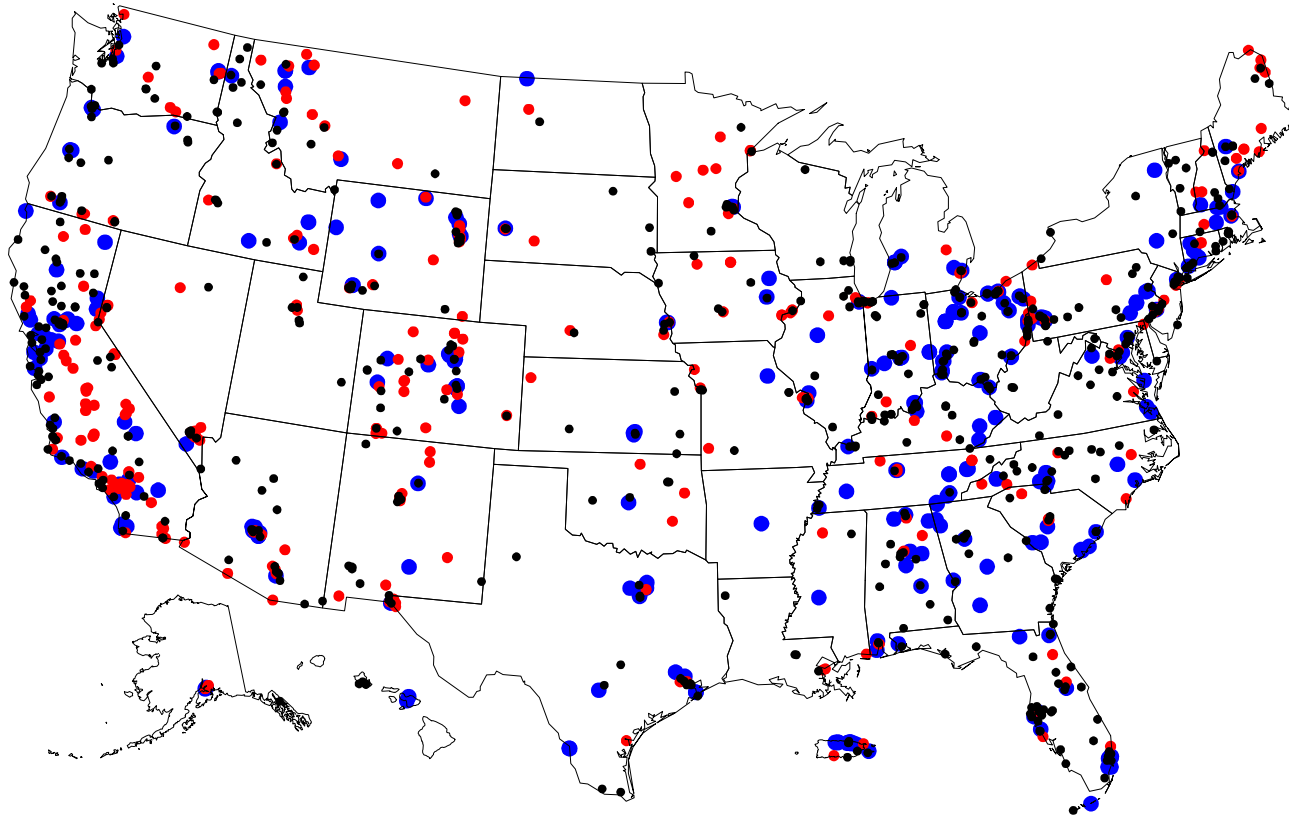# Red=Large Value, Blue=Small Value

PM10 2nd Max: Red=Large Value, Blue=Small Value

Predicting PM10 Annual Mean:
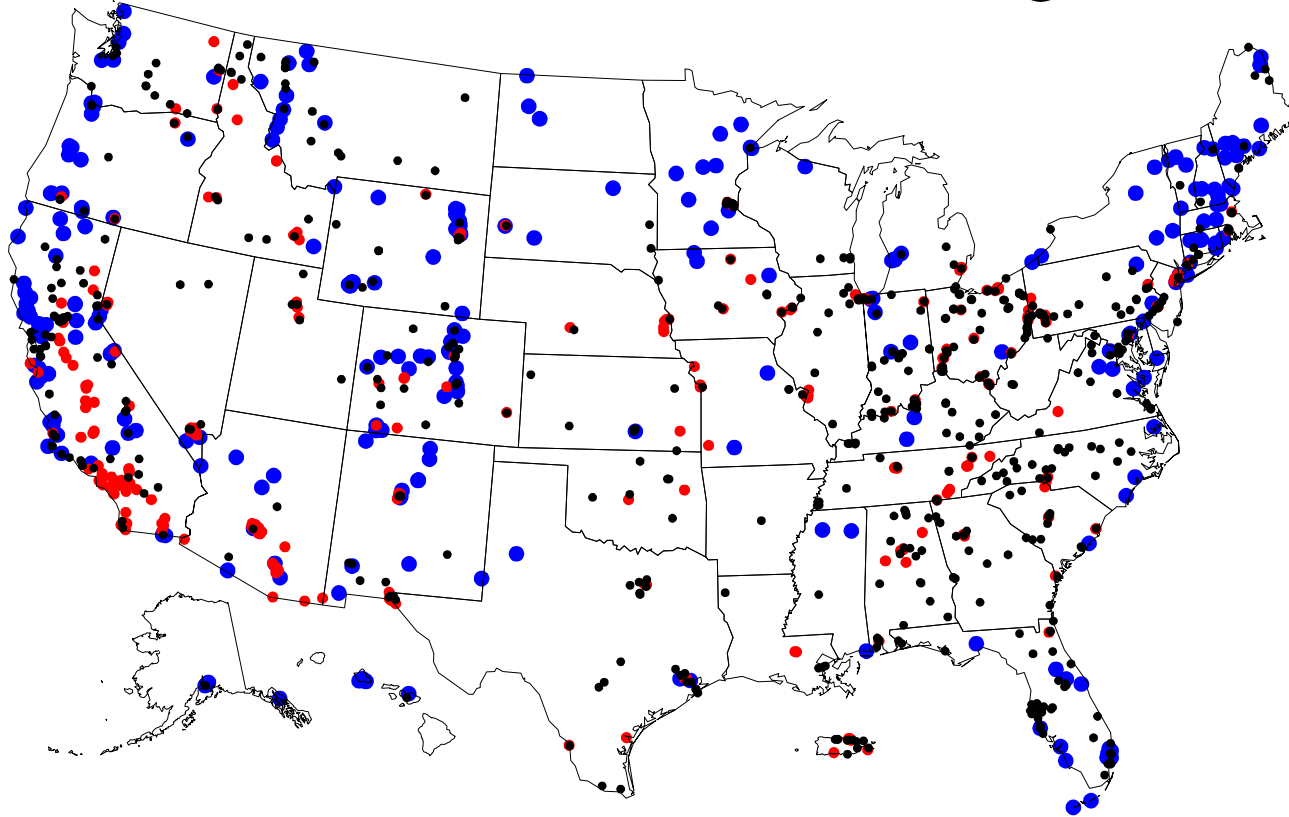# Red=High Uncertainty, Blue=Low Uncertainty

Predicting PM10 Annual Mean: Red=High Uncertainty, Blue=Low Uncertainty

Predicting PM10 2nd Max:
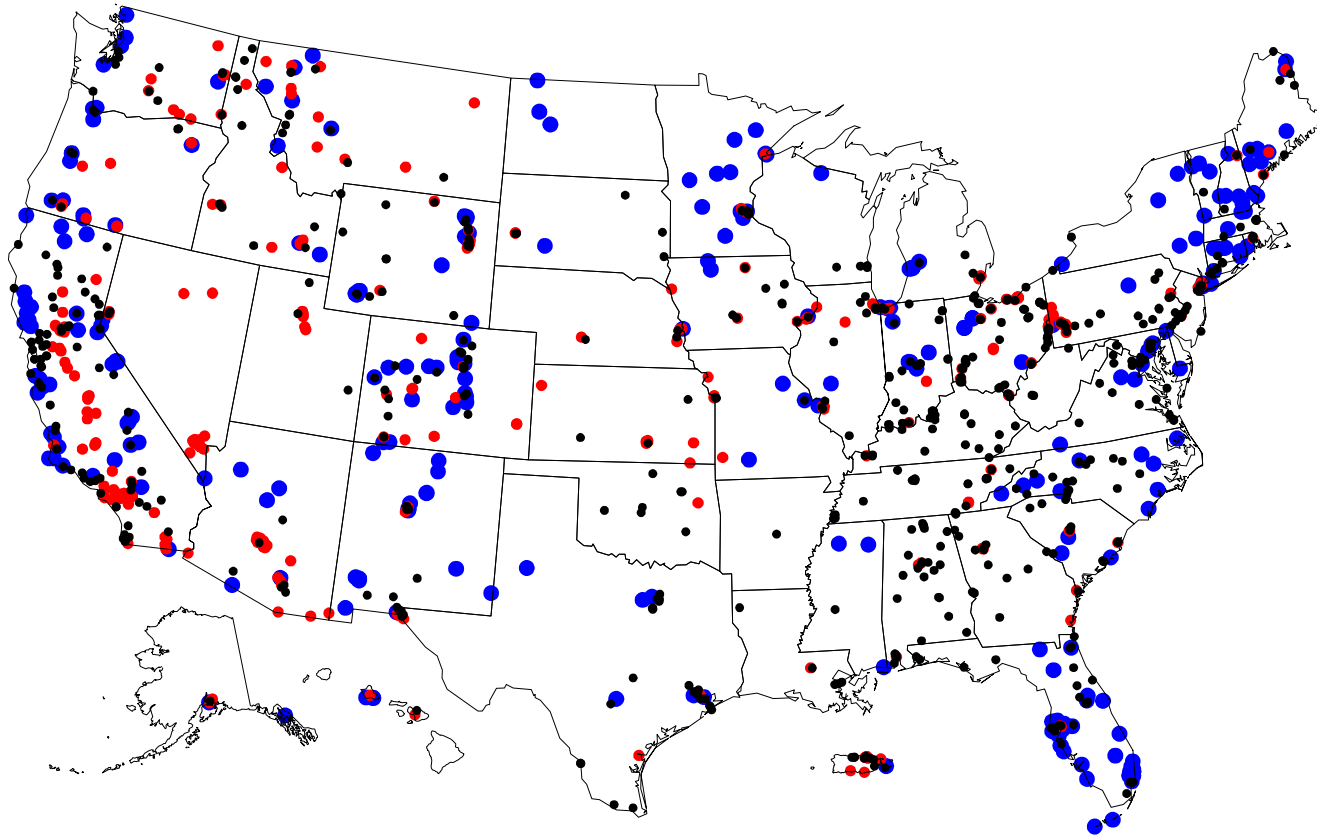# Red=High Uncertainty, Blue=Low Uncertainty

Predicting PM10 2nd Max: Red=High Uncertainty, Blue=Low Uncertainty

# Deviation from PM10 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation

Deviation from PM10 Annual Mean NAAQS: Red=Small Deviation, Blue=Large Deviation

Deviation from PM10 24-Hour NAAQS:
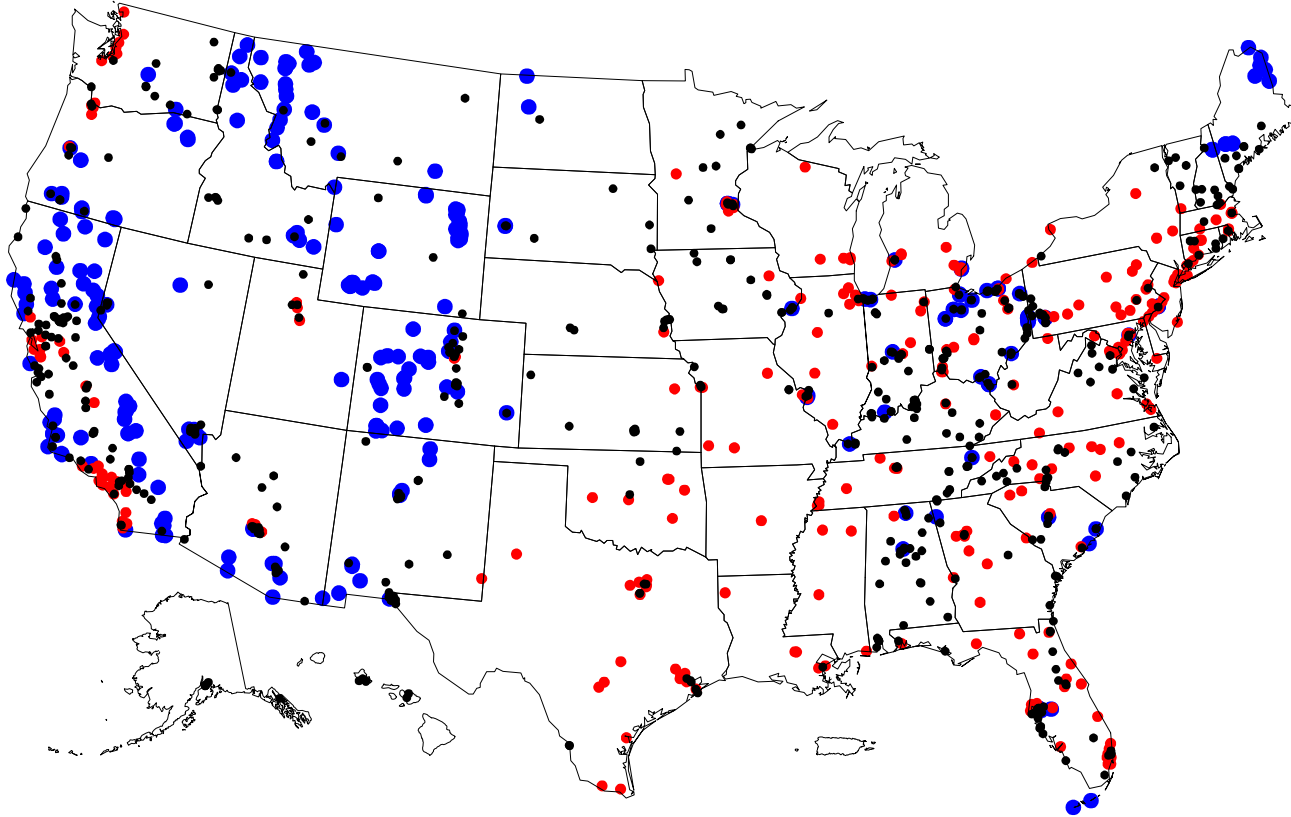# Red=Small Deviation, Blue=Large Deviation

Deviation from PM10 24-Hour NAAQS: Red=Small Deviation, Blue=Large Deviation

Area for PM10 Monitors:
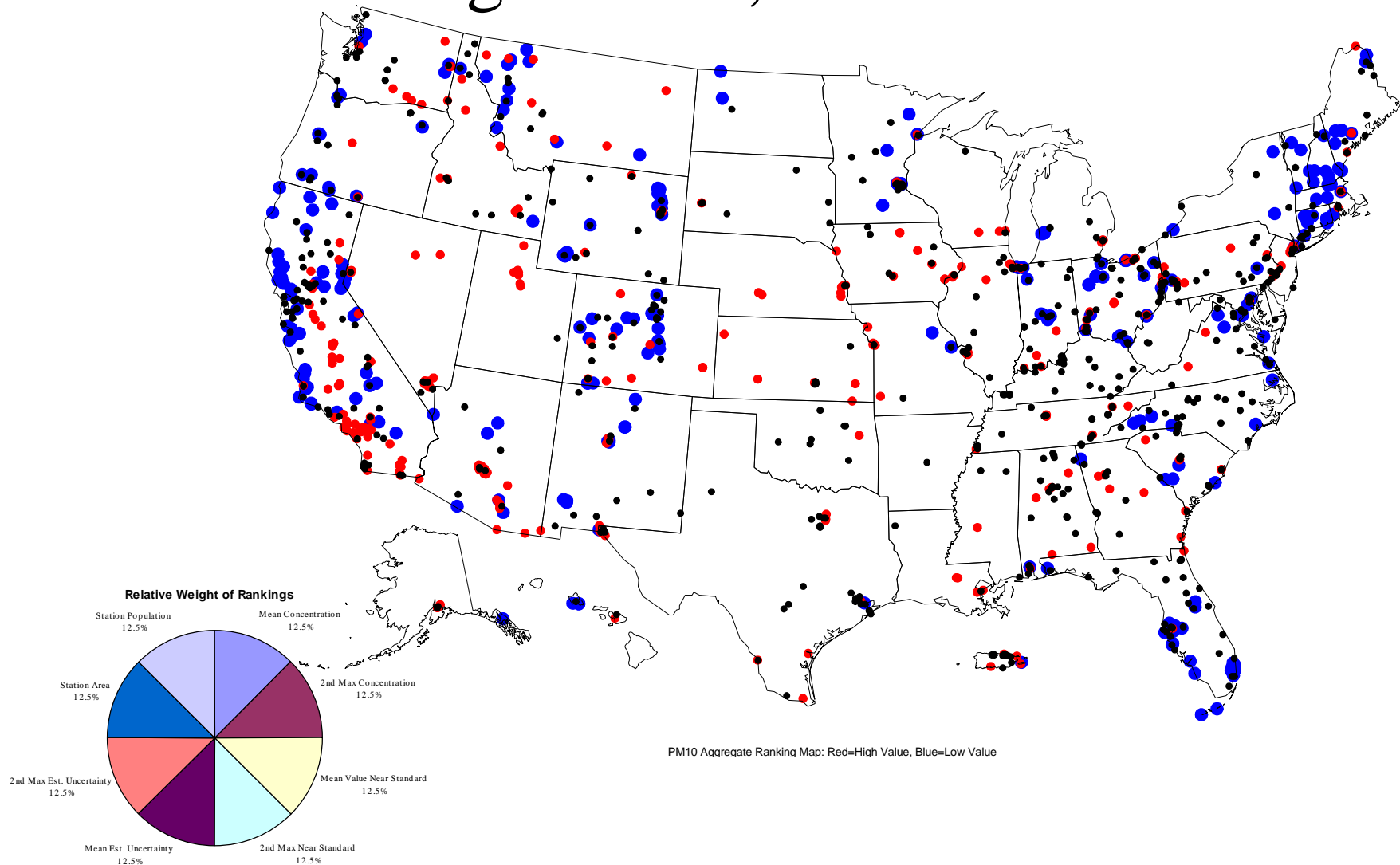# Red=Large Area, Blue=Small Area
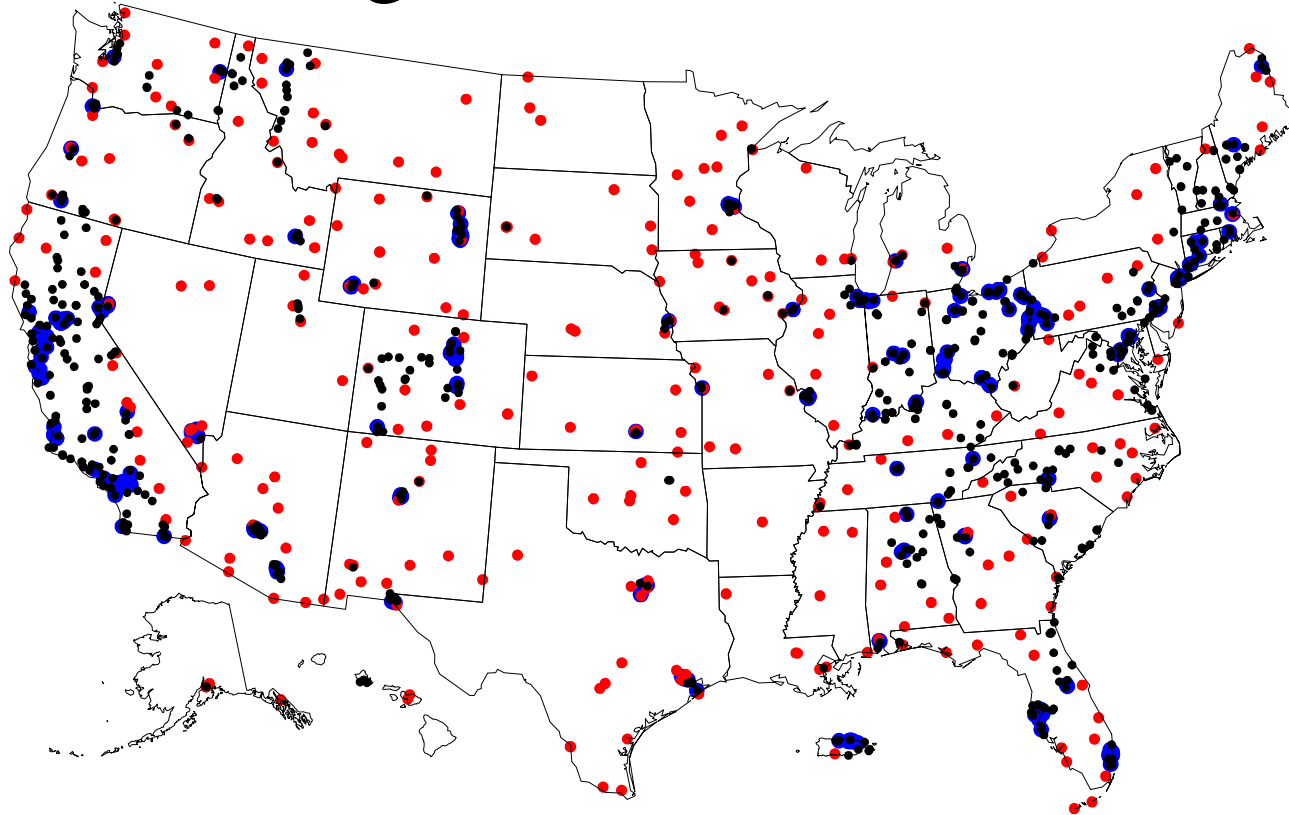
Area for PM10 Monitors: Red=Large Area, Blue=Small Area

Population for PM10 Monitors:
Red=Large Population, Blue=Small Population

Population for PM10 Monitors: Red=Large Population, Blue=Small Population

PM10 Aggregate Ranking Map:
# Red=High Value, Blue=Low Value

**Relative Weight of Rankings**

Station Population
12.5%

Mean Concentration
12.5%

Station Area
12.5%

2nd Max Concentration
12.5%

2nd Max Est. Uncertainty
12.5%

Mean Value Near Standard
12.5%

Mean Est. Uncertainty
12.5%

2nd Max Near Standard
12.5%

PM10 Aggregate Ranking Map: Red=High Value, Blue=Low Value

PM10 Quartiles

	PM10							
	pm10mean	pm102x	pm10meanerr	pm102xerr	dif_NAAQS_mean	dif_NAAQS_2x	area	population
Q1	27.8	66.7	8.60625	24.08809	22.3	84.3	8728.96	308375.5
Q3	19.4	42.7	1.9877	5.51636	30.6	107.3	1002.49	44376.5

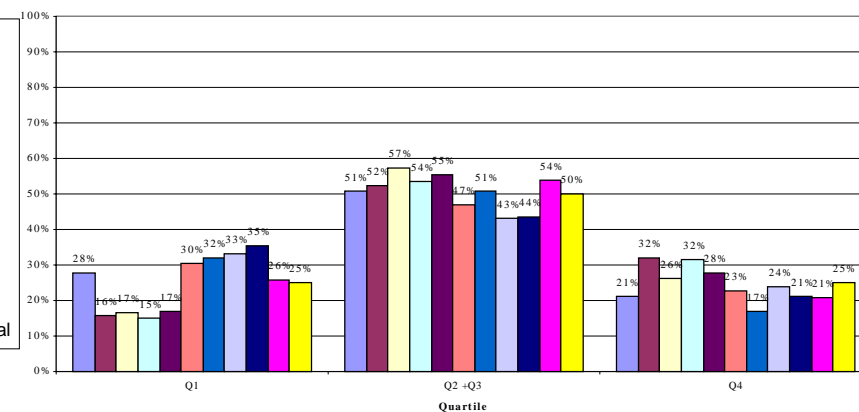# Regional Percent of Sites in National Quartiles

PM10 Annual Mean Concentration
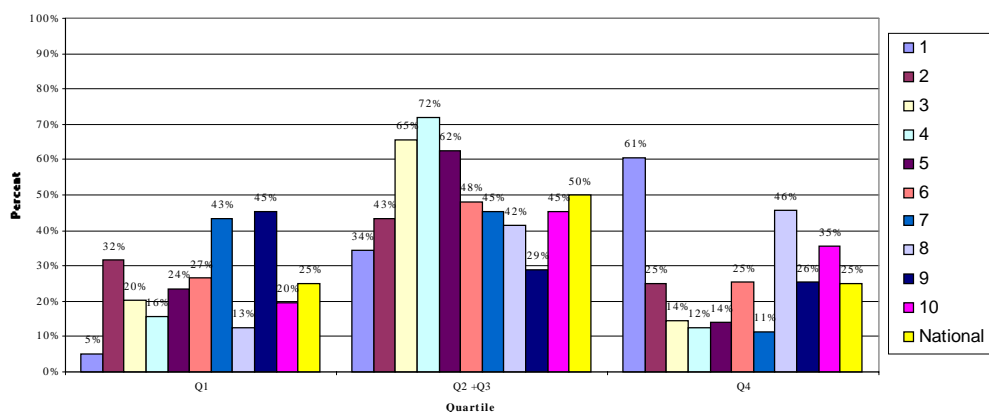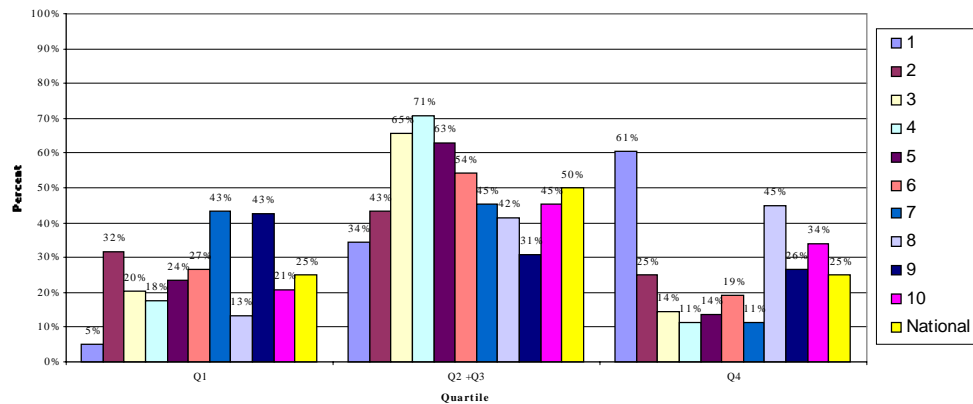
PM10 2nd Max Concentration
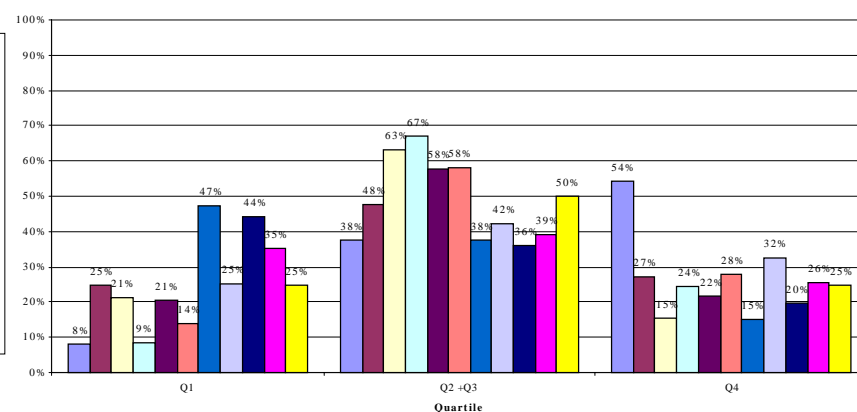
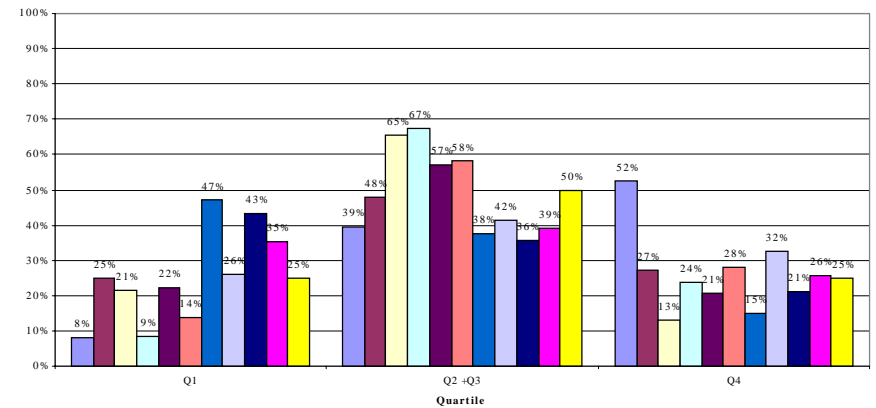PM10 Annual Mean Uncertainty
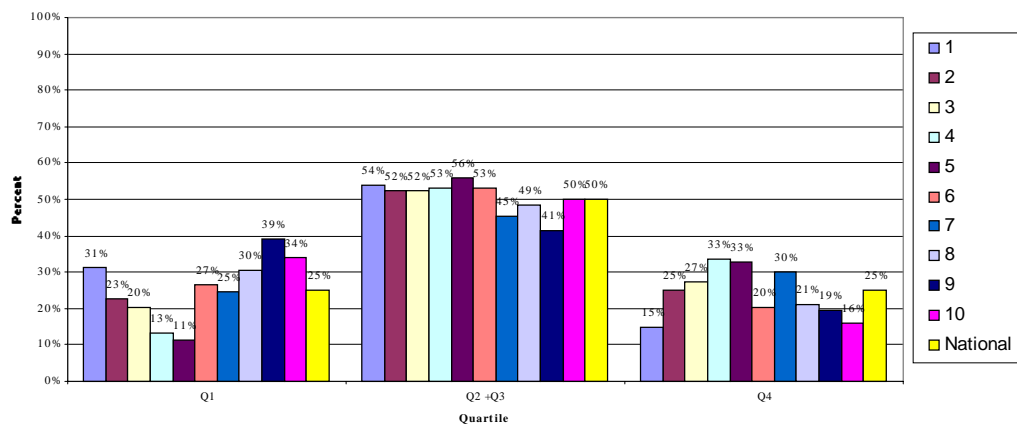
PM10 2nd Max Uncertainty
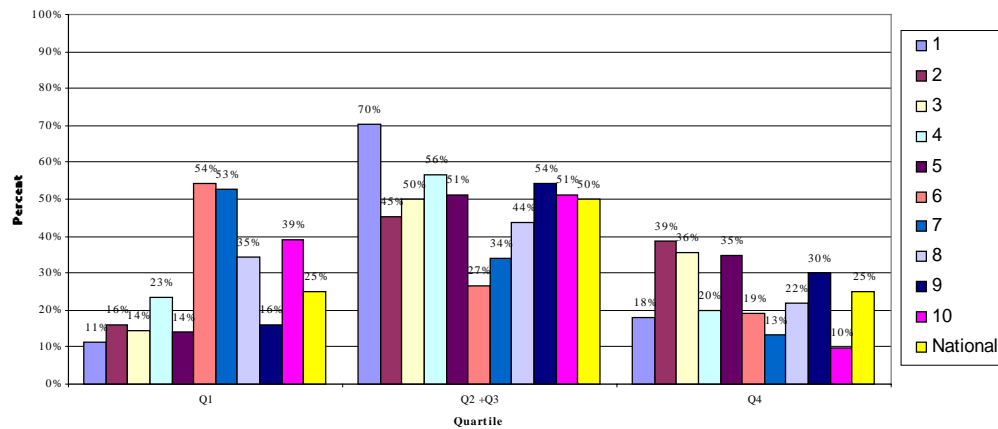
Regional Percent of Sites in National Quartiles

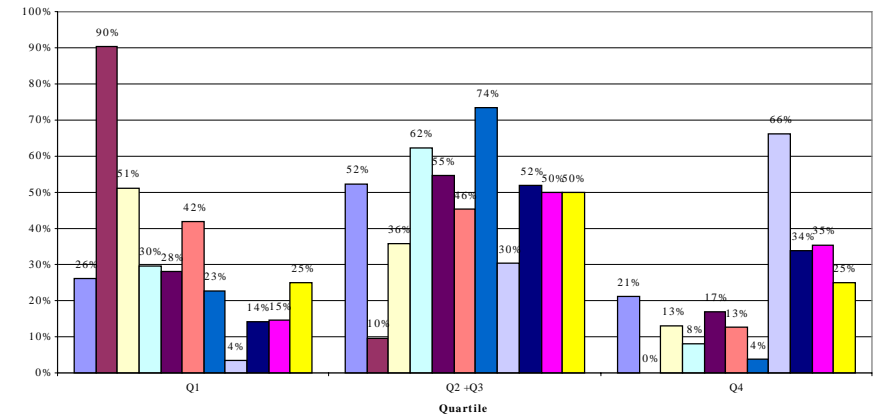PM10 Annual Mean Deviation from NAAQS

PM10 2nd Max Deviation from NAAQS
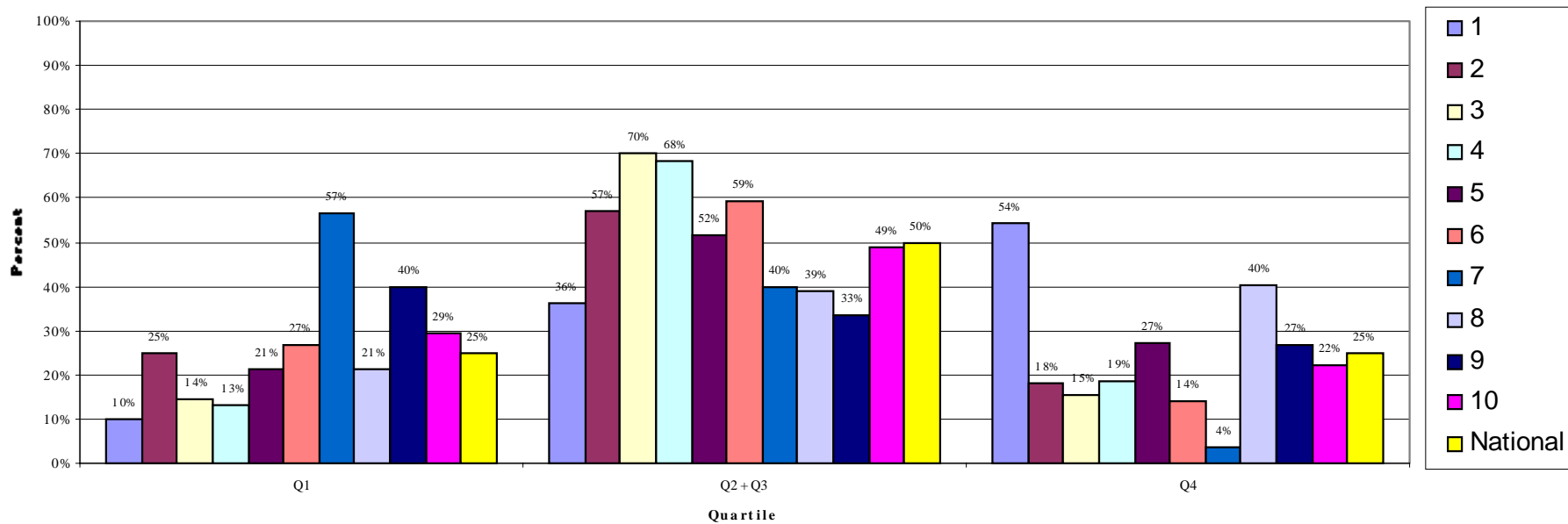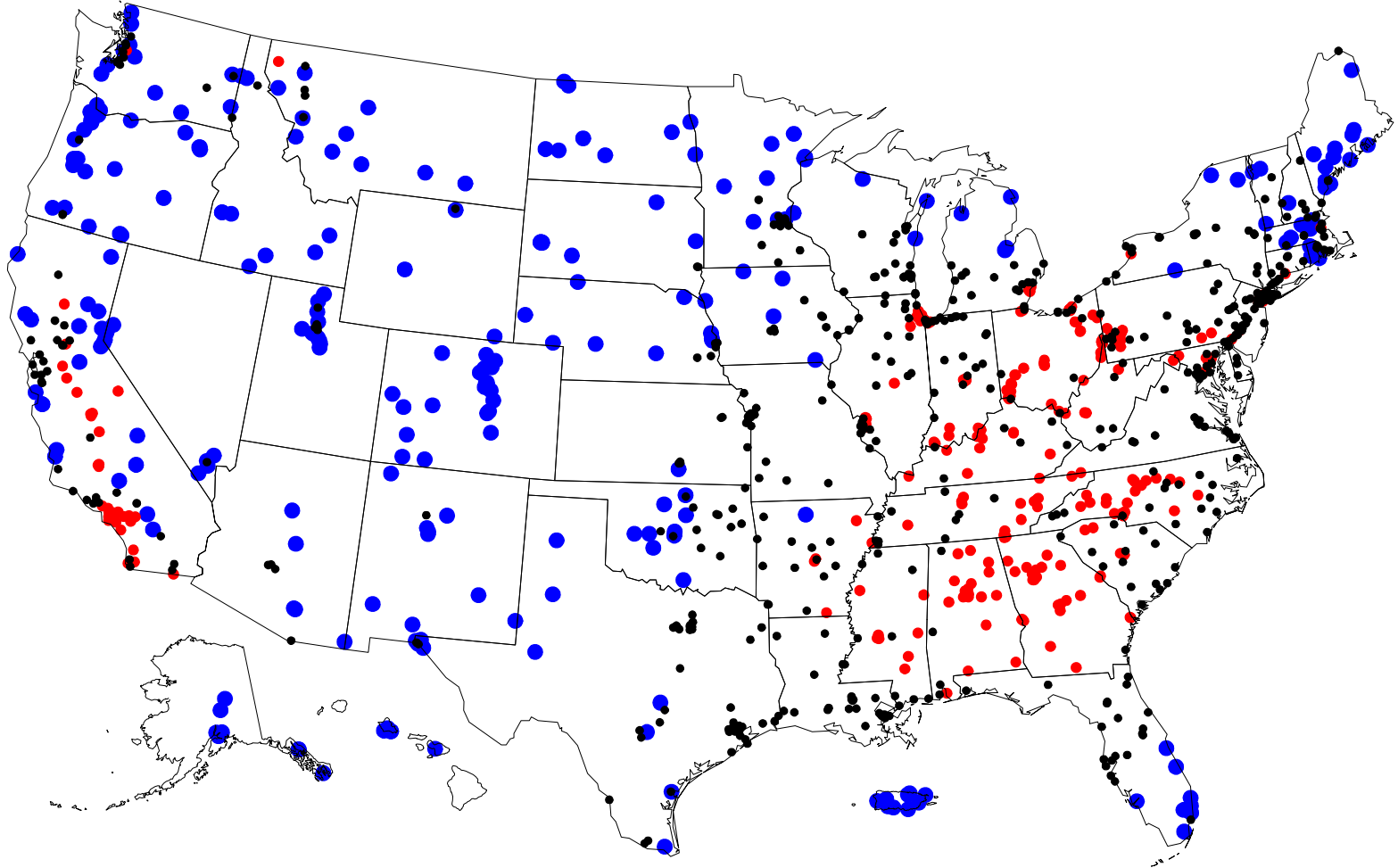
PM10 Area

PM10 Population

Regional Percent of Sites in National Quartiles

PM10 Aggregate Data

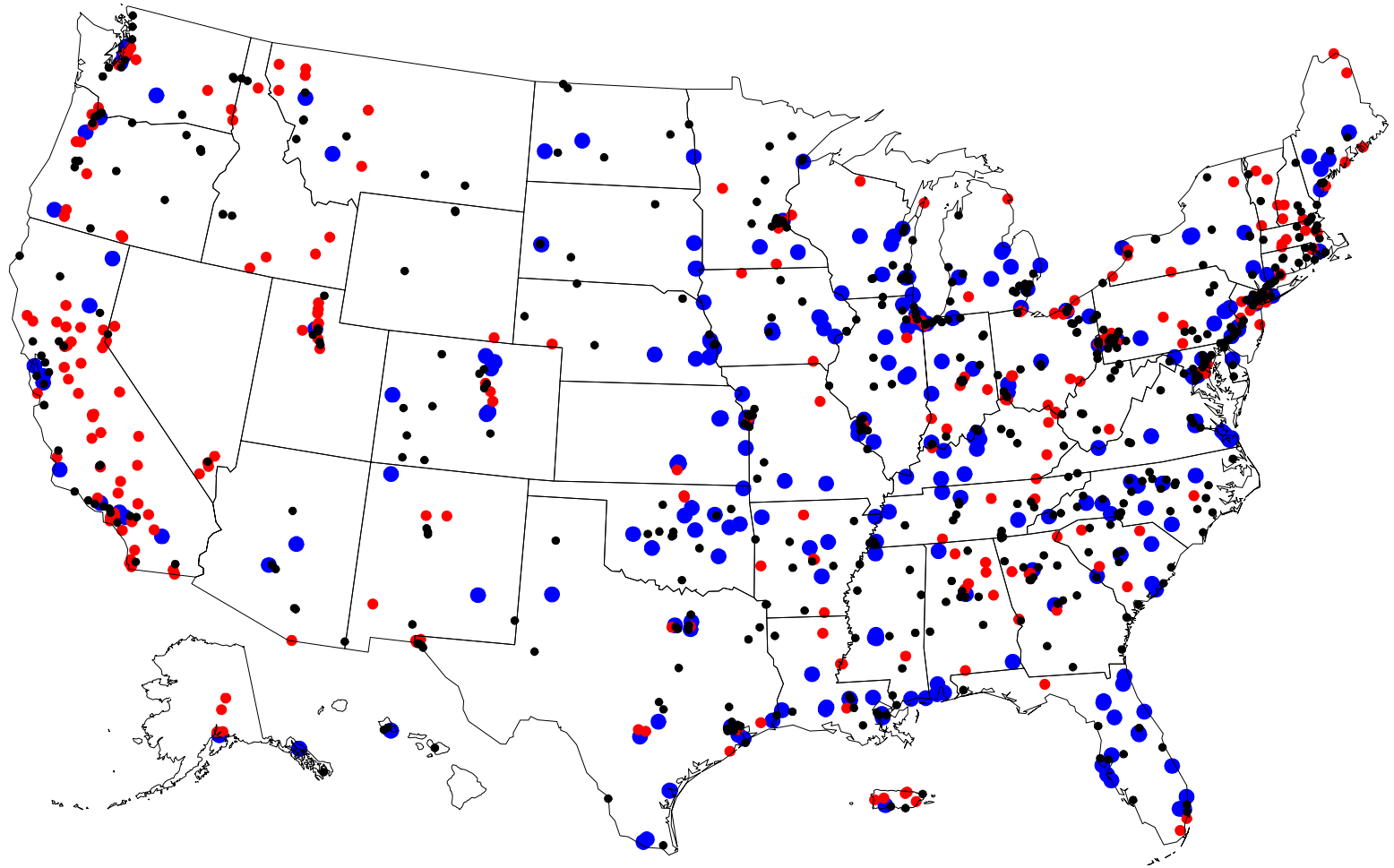# PM25 Annual Mean:
Red=Large Value, Blue=Small Value

PM25 Annual Mean: Red=Large Value, Blue=Small Value

PM25 98th Percentile:
Red=Large Value, Blue=Small Value

PM25 98th Percentile: Red=Large Value. Blue=Small Value
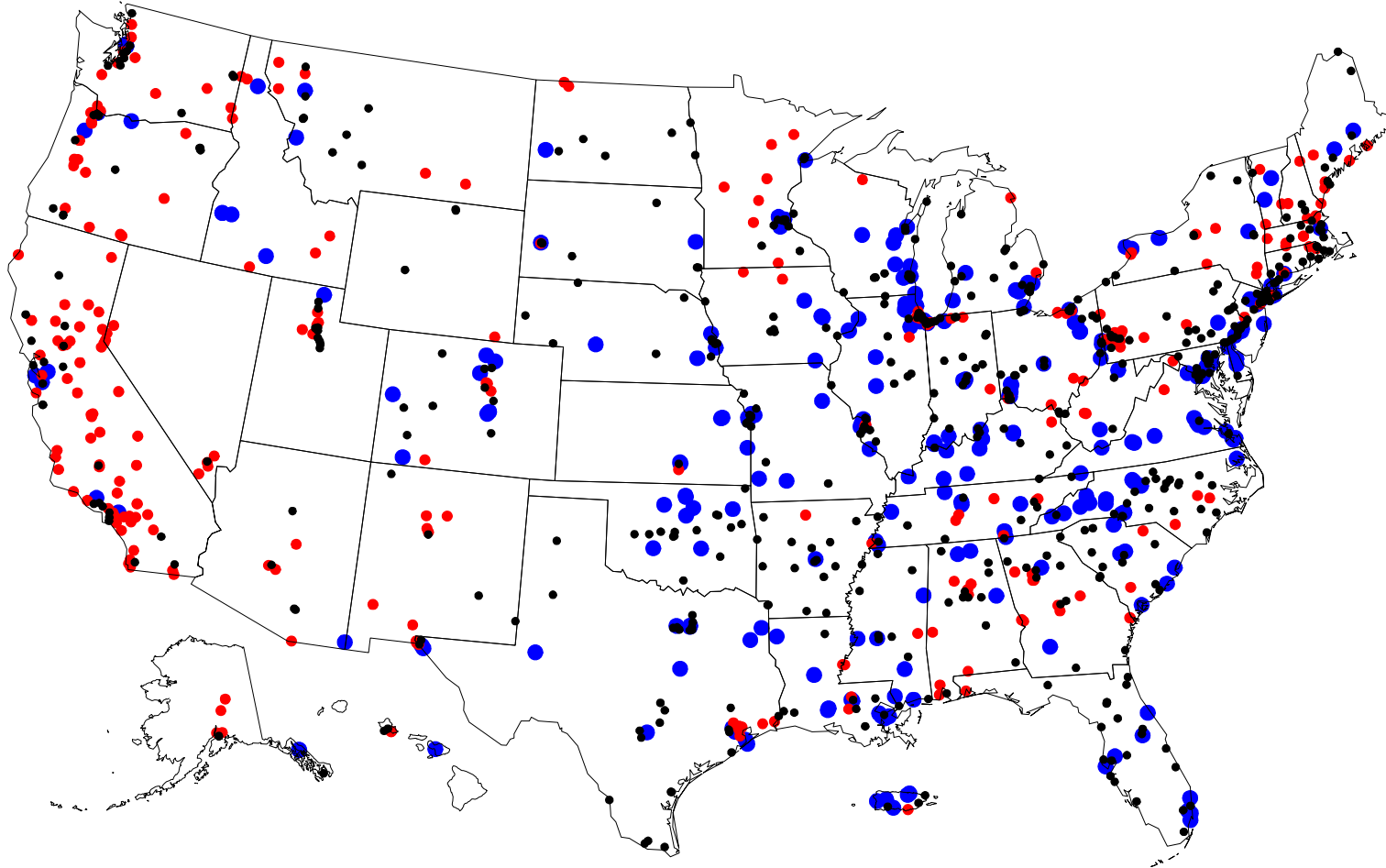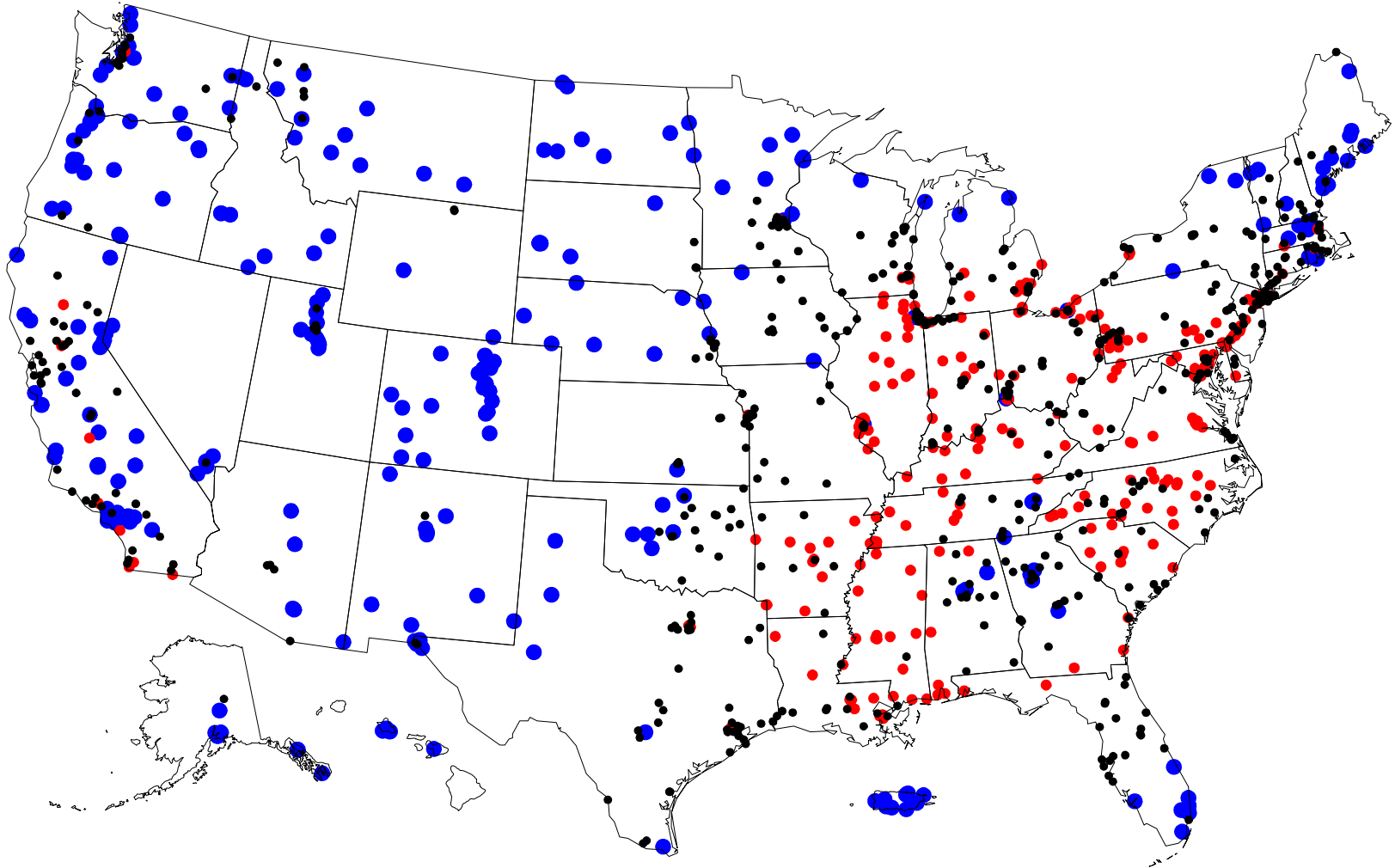
Predicting PM25 Annual Mean: Red=High Uncertainty, Blue=Low Uncertainty

Predicting PM25 98th Percentile: Red=High Uncertainty, Blue=Low Uncertainty
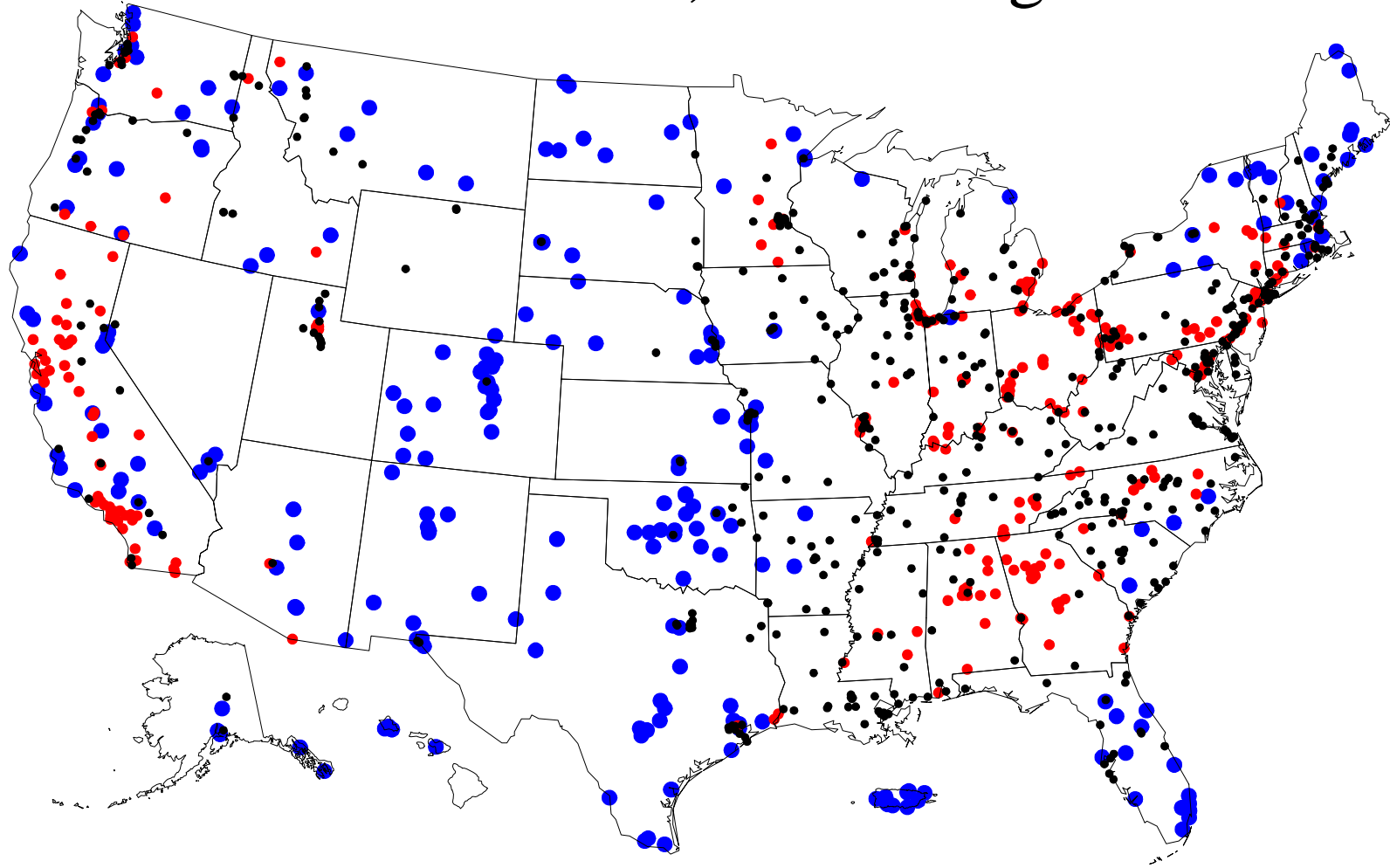
Deviation from PM25 Annual Mean NAAQS:
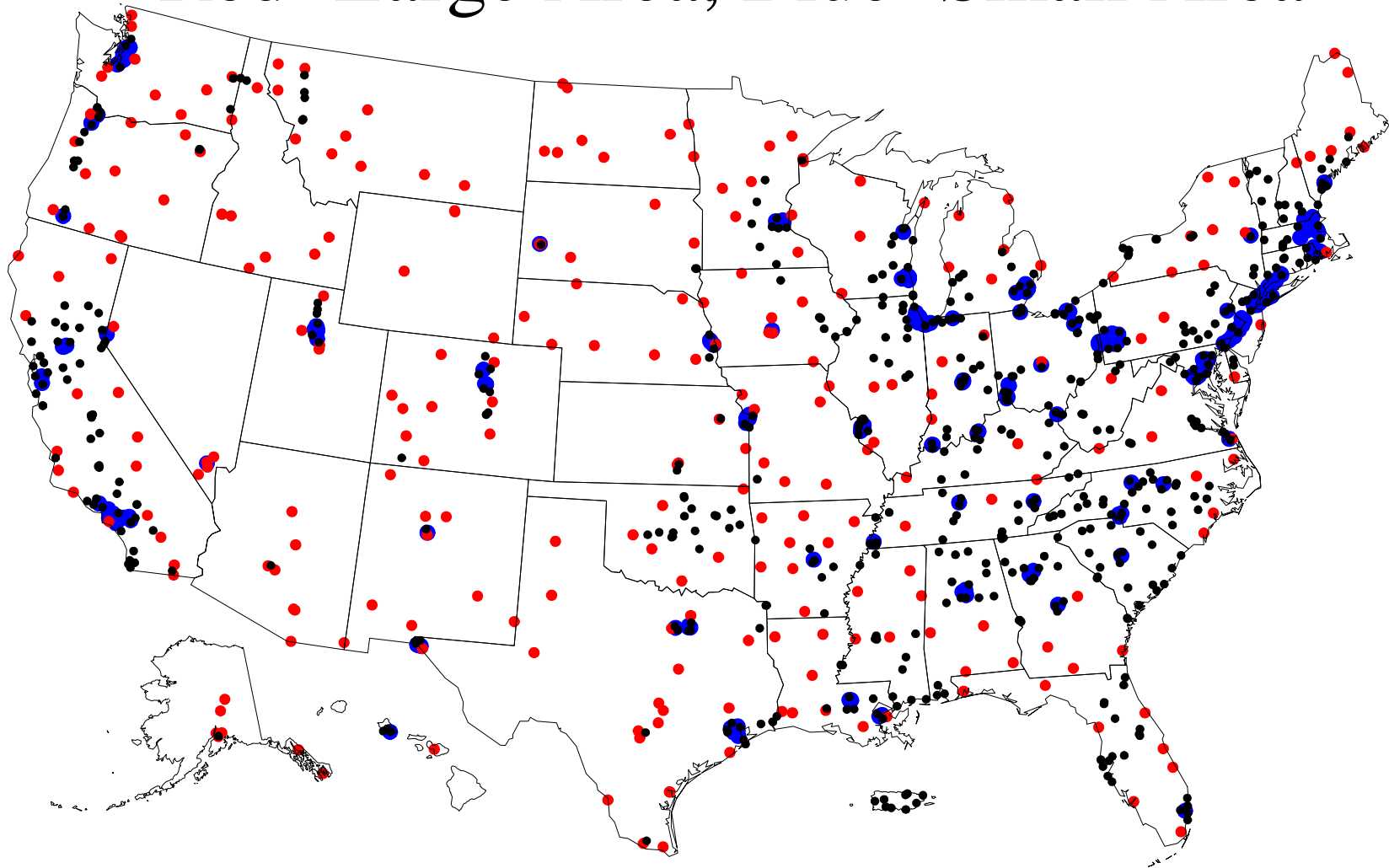# Red=Small Deviation, Blue=Large Deviation

Deviation from PM25 Annual Mean NAAQS: Red=Small Deviation. Blue=Large Deviation

Deviation from PM25 98th Percentile NAAQS: Red=Small Deviation. Blue=Large Deviation
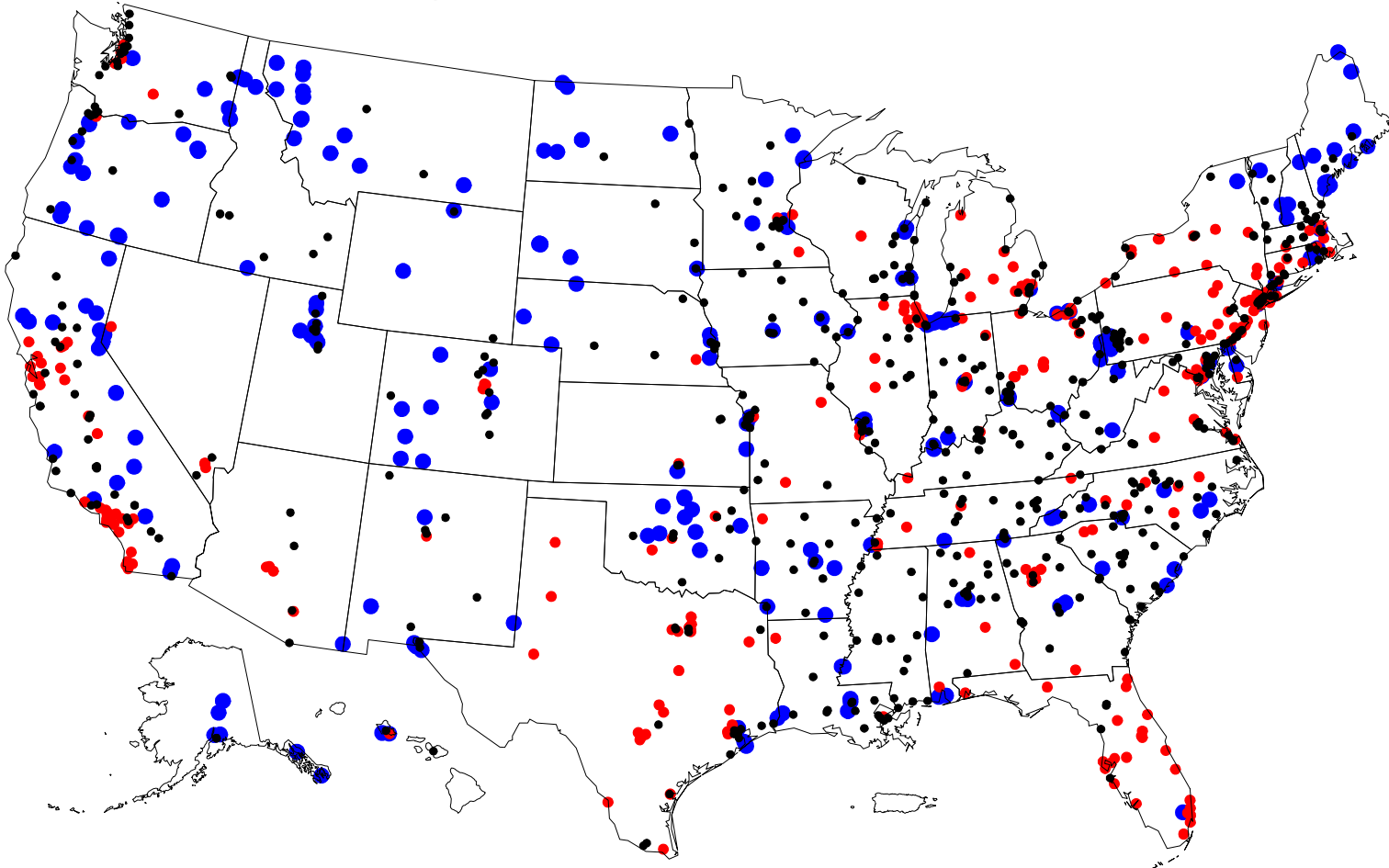
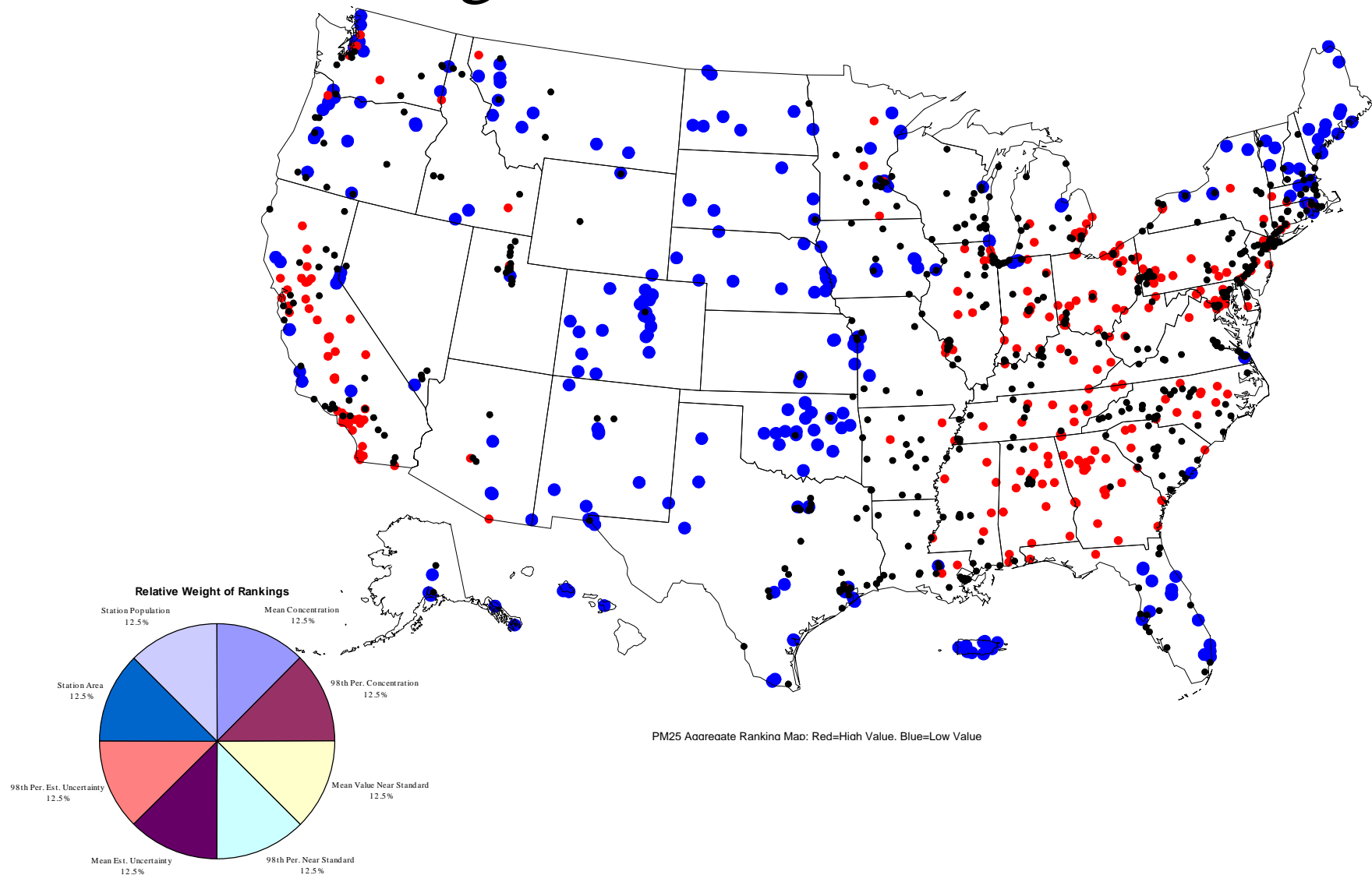# Area for PM25 Monitors:
Red=Large Area, Blue=Small Area

Area for PM25 Monitors: Red=Large Area. Blue=Small Area

Population for PM25 Monitors:
Red=Large Area, Blue=Small Area

Population for PM25 Monitors: Red=Large Population, Blue=Small Population

PM25 Aggregate Ranking Map:
Red=High Value, Blue=Low Value

Relative Weight of Rankings

Station Population
12.5%

Mean Concentration
12.5%

98th Per. Concentration
12.5%

Station Area
12.5%

Mean Value Near Standard
12.5%

98th Per. Est. Uncertainty
12.5%

Mean Est. Uncertainty
12.5%

98th Per. Near Standard
12.5%

PM25 Aggregate Ranking Map: Red=High Value, Blue=Low Value

PM25 Quartiles

	PM25							
	pm25mean	98th percent	pm25error	98th per. error	dif_NAAQS_mean	dif_NAAQS_98	area	population
Q1	15.5	38	1.75445	5.8182	1.2	28	9300.75	322779
Q3	10.4	27	0.4174	1.2032	4.95	38	1188.46	109192

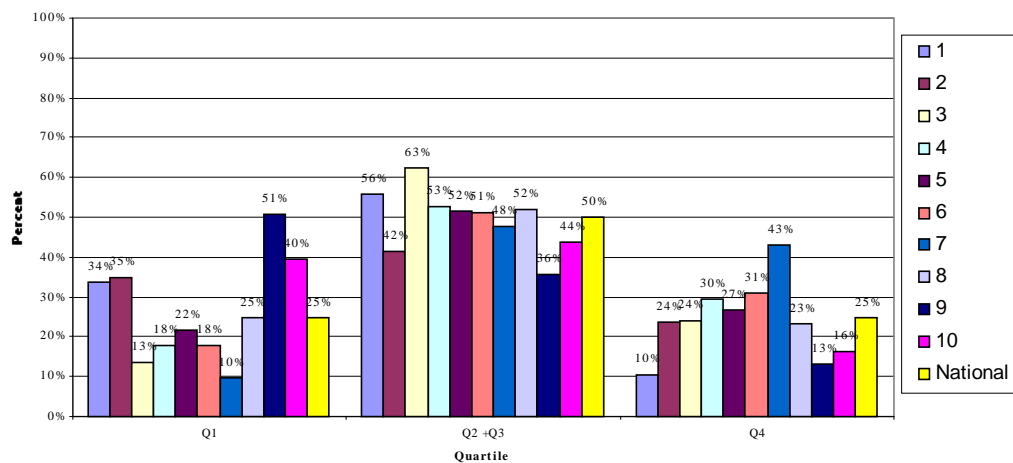# Regional Percent of Sites in National Quartiles
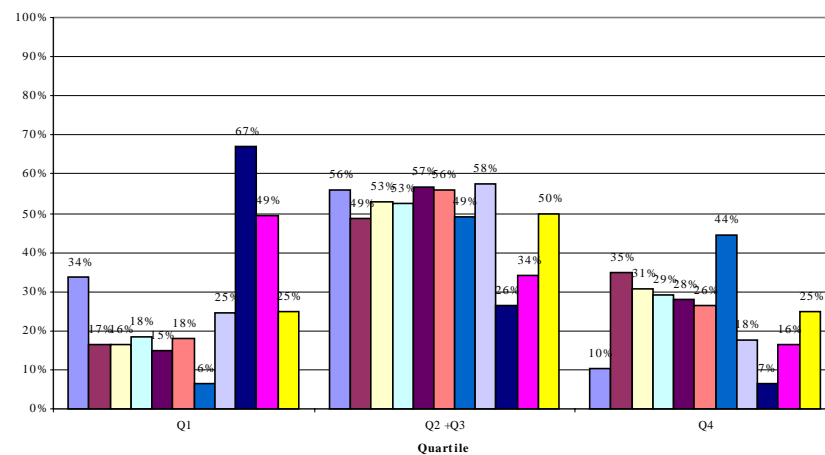
PM25 Annual Mean Concentration
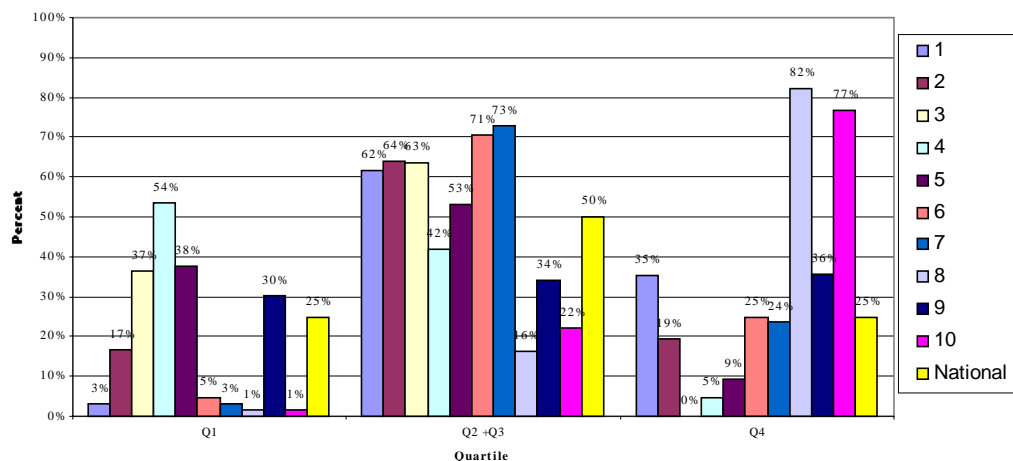
PM25 98th Percentile Concentration
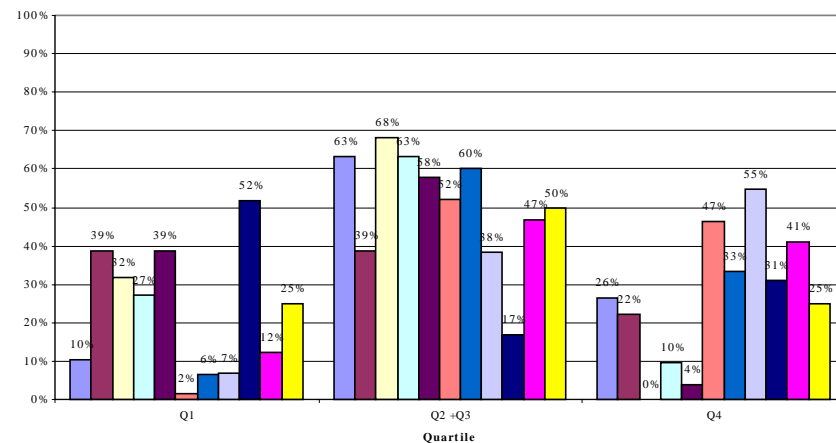
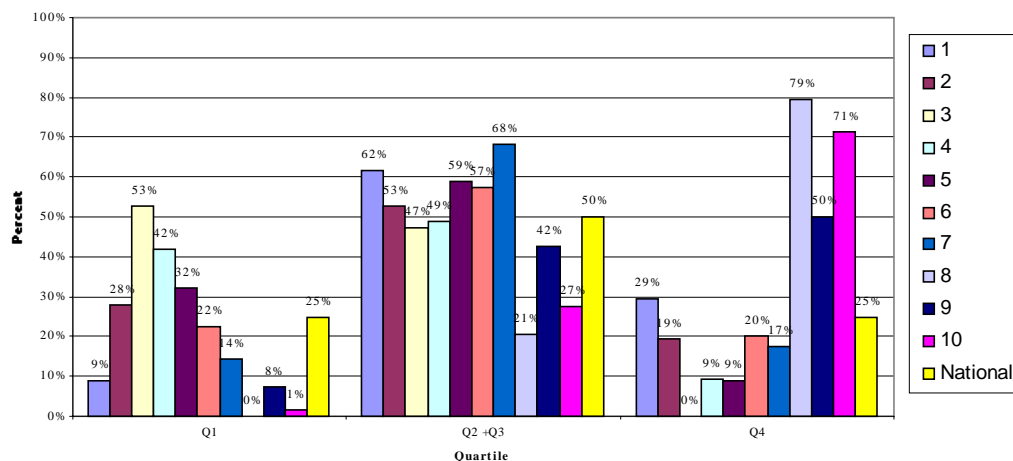### PM25 Annual Mean Uncertainty

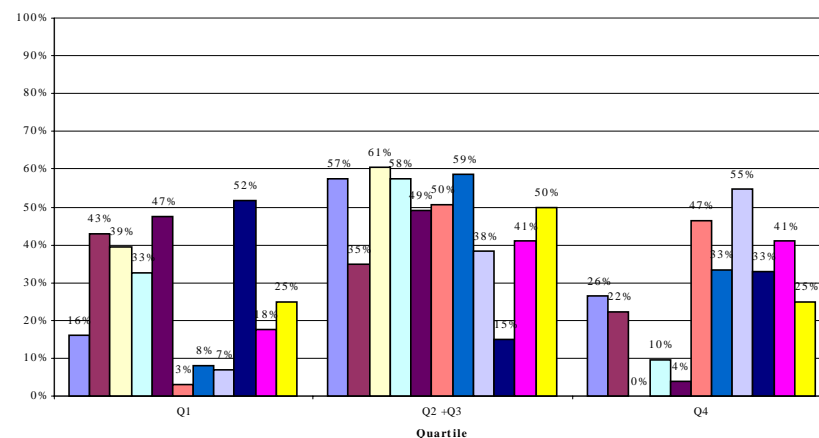
PM25 98th Percentile Uncertainty

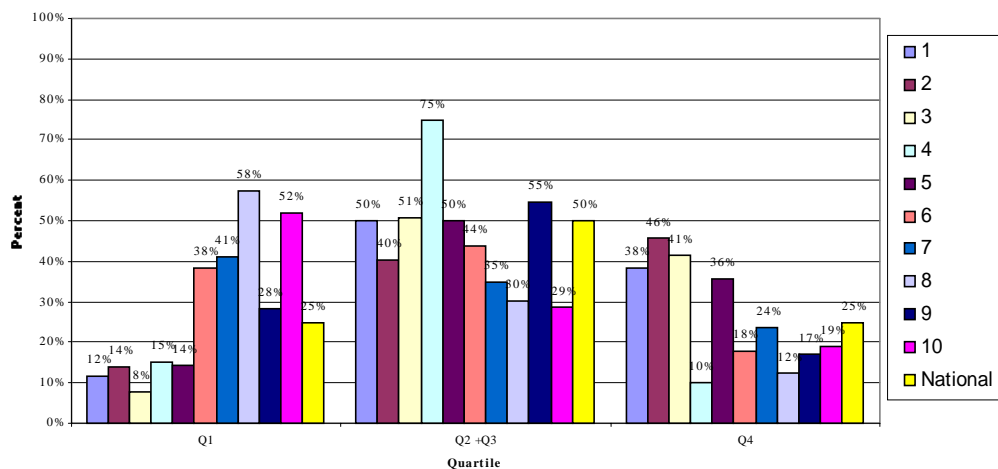# Regional Percent of Sites in National Quartiles

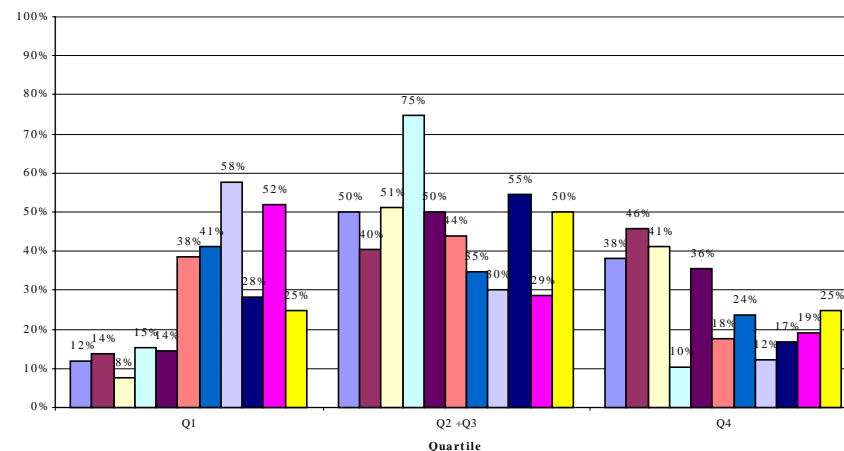PM25 Annual Mean Deviation from NAAQS

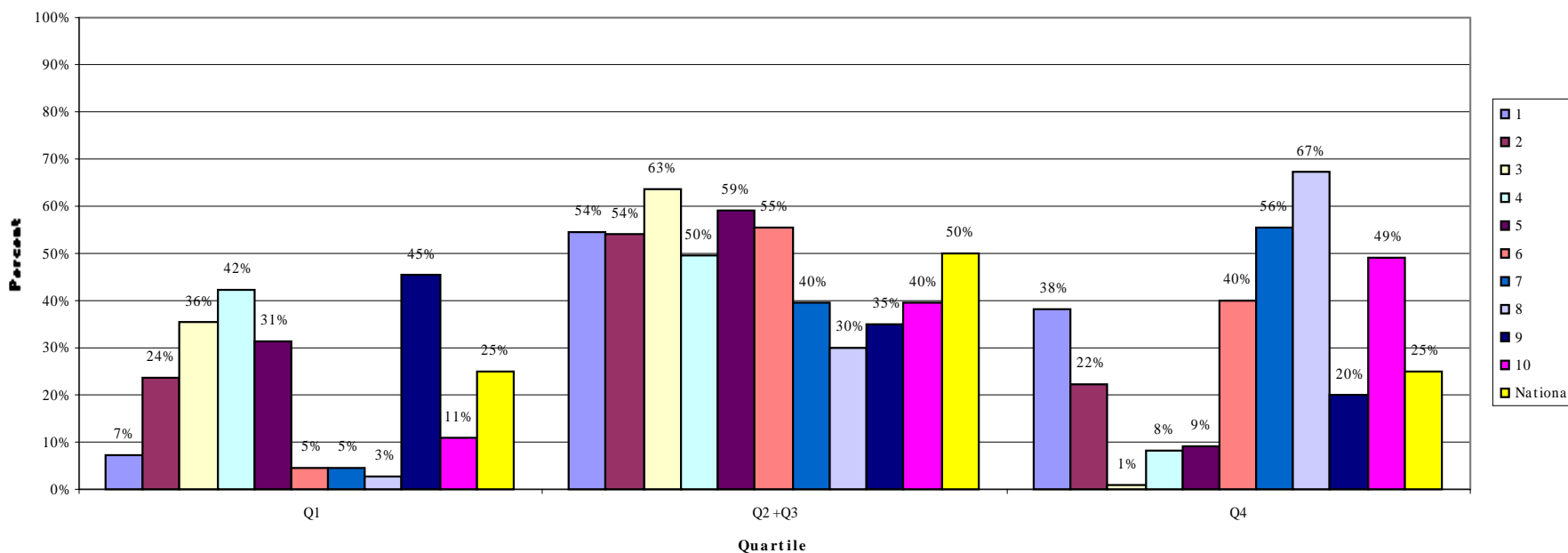PM25 98th Percentile Deviation from NAAQS

PM25 Area

PM25 Population

Regional Percent of Sites in National Quartiles

PM25 Aggregate Data

Aggregate Ranking Map for All Pollutants: Red=High Value, Blue=Low Value

Relative Weight of Rankings

- O3 8hr 12.5%
- CO 12.5%
- NO2 12.5%
- SO2 12.5%
- Pb 12.5%
- PM10 12.5%
- PM25 12.5%
- O3 1hr 12.5%

Aggregate Ranking Map for All Pollutants: Red=High Value, Blue=Low Value